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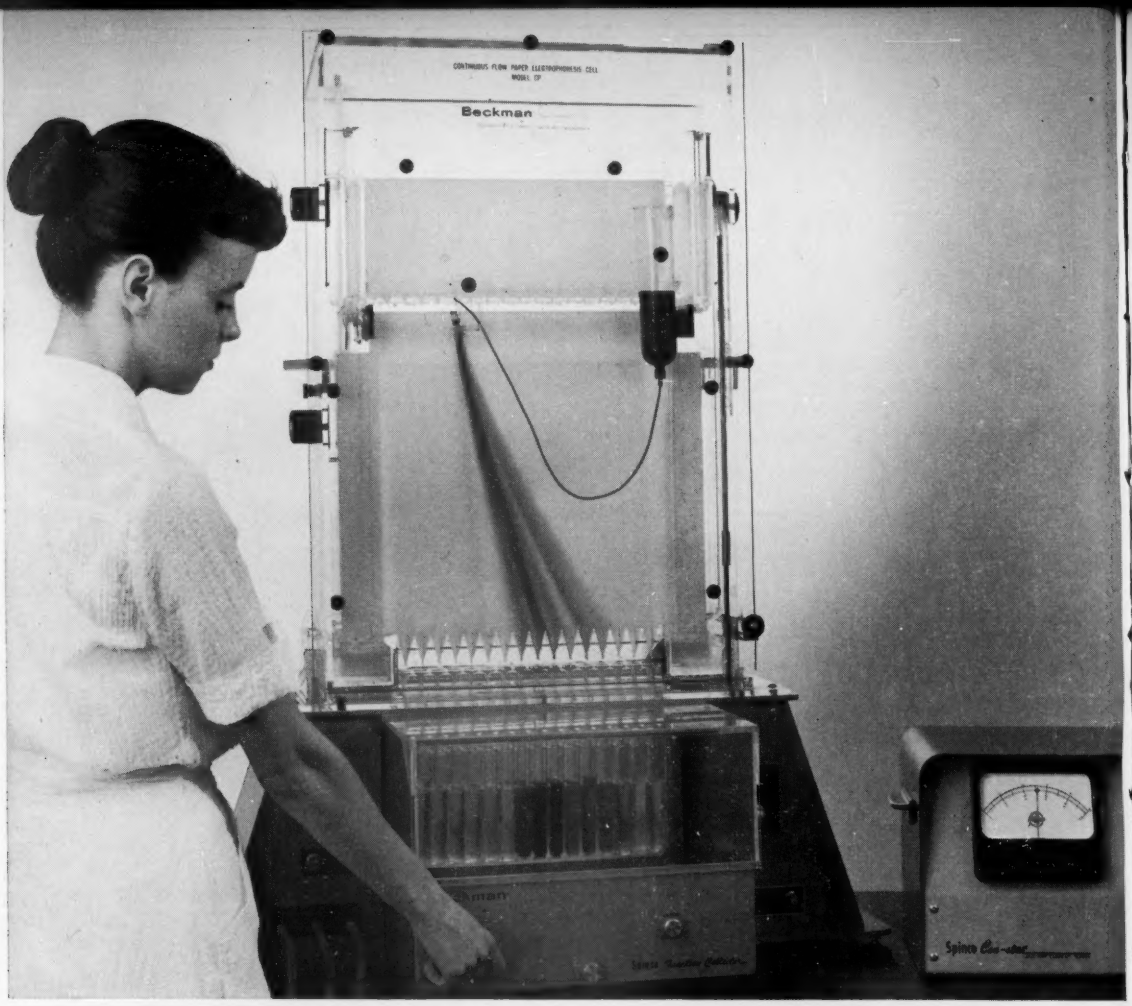

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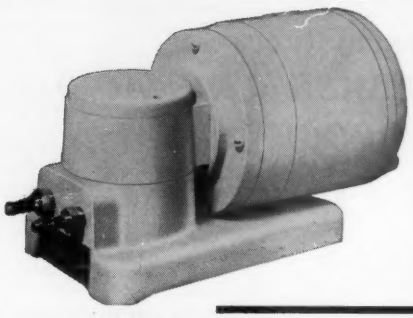

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Silver Lining

Public attention has, quite understandably, been focused on the dangerous aspects of nuclear radiation, on the potentiality of genetic damage, and, if worst comes to worst, on the possibility of total or near-total destruction of the human race. The recent political campaign has kept the dangers much in the public mind. The image of the mushroom cloud and the thought of the lethal rain from heaven (or fallout from the stratosphere) give us ample reason for anxiety.

But there is a silver lining to the mushroom cloud. Owing to the use of radioactive and other isotopes as tracers, our understanding of metabolic processes in plants and animals is progressing more rapidly than at any time in history; diagnosis and treatment of many diseases have been facilitated and great progress has been made in the study of soil mechanics and of wear in metals, to mention only a few of the many possible examples. We can scarcely doubt that the research made possible by man-made radioactive and other isotopes will lead to an understanding of fundamental processes that will yield great benefits to man's health and material welfare.

Similarly, great potential benefits are to be expected from the application of nuclear energy to the generation of electricity. Especially in countries with dwindling sources of coal and oil and with inadequate sources of hydroelectric power, the development of power reactors should play an important economic role. In the United Kingdom, for example, restrictions in the conventional sources of power have stimulated rapid advance in the design and construction of nuclear reactors for power production. The recent completion of the reactor at Calder Hall is a noteworthy beginning in the large-scale production of commercially significant amounts of power. According to Sir George Thomson, in an address to the British Association for the Advancement of Science, by 1975 the U.K. will be deriving about 40 percent of its total power from nuclear energy at a saving of about 40 million tons of coal per year. The importance of this is the more obvious when it is considered in connection with the fact that in recent years the U.K. has changed from an exporter to an importer of coal. "Carrying coals to Newcastle" no longer conveys the notion of a superfluous act. As Sir George said in reference to the nuclear power program, "There have been few cases in economic history in which a discovery has come so completely in the nick of time."

The technical possibilities of our times are almost unlimited. It is technically possible for all nations to benefit from the nuclear age in improved health, better materials, and more power. It is technically possible to reduce, if not to eliminate, the economic disparities among nations and correspondingly to reduce the chances of war for economic advantage.

Technical possibilities are one thing, political possibilities are another. It is a hopeful political sign that 82 nations in the U.N. have now agreed to a statute for the International Atomic Energy Agency, an agency created to "accelerate and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world." Even the least altruistic among us ought to hope that the new agency will succeed.—G. DUS.

9 November 1956, Volume 124, Number 3228 SCIENCE

University Responsibilities and Government Money

Paul E. Klopsteg

Increasing concern over the implications of competition in weapons of annihilation is stimulating action to rectify our shortage of engineers and scientists. On 3 April 1956, the President issued a statement on the subject and appointed a commission to deal with the matter. Many well-informed persons emphasize the important role of scientists who are competent in basic research in the increase of knowledge that may be indispensable, not only to our security, but to our economy and welfare as well.

In this situation our nation's future will be as good as we choose to make it. The better our intelligent, well-planned attack on the problem, the greater will be the additions to significant knowledge essential to progress. A determined and sustained effort in basic research is imperative. "Knowledge is power" fits the situation precisely, and basic research is the key.

A realistic appraisal of the importance of the subject is indicated (*1*). It is no departure from realism to recognize that practical application of knowledge is not the only justification for seeking it. In a provocative essay Alfred Stern (*2*) shows, by remarks of Epictetus and Herodotus, that the original meaning of philosophy is contemplation for the sake of contemplation, a search for knowledge in order to *know* and not in order to *act*; and he quotes the opening statement in Aristotle's *Metaphysics*, "All men by nature desire to know." Motivated by intellectual curiosity, the attempt to penetrate the unknown applies to the whole body of knowledge, of which science is a part. It is in the pattern of our culture for society to encourage and support specially gifted minds in their eternal quest. Research in science under the conditions of our time is a large and important part of the search, both because of the need to understand more fully our physical environment and because of its over-all social implications.

Dr. Klopsteg is associate director of the National Science Foundation. This is the first in a series of two articles. The second article, entitled "How shall we pay for research and education?" will appear next week.

Unlimited Funds Not an Answer

With such realism as we can muster, we must say that the outpouring of unlimited funds for research in science is neither necessary nor sufficient to assure maximum returns. These are determined by the quality of the work and less directly by the quantity of money employed in its furtherance. The limitation to the production of new and significant knowledge is the competence and number of research scholars.

The major concentration of these relatively few gifted persons is in the colleges and universities where postgraduate studies are pursued. If we seek a maximum of significant contributions to science, we must look to the institutions of higher education as their principal source and, by some rational process, assure their support. We must make sure also that there is a steady increase in the number of capable research scientists by inducing able young persons to choose scholarly careers. It would be visionary to suppose that all of them could or would become academic scholars, in view of the limited number of tenure positions in universities. These posts should be held by those of highest competence. But there are many scientists of unusual ability who are not drawn to the academic life, and who find satisfying careers in industrial and government laboratories. All of them are the product of institutions of higher education.

Government Money Mostly for Applied Research

Since World War II, the flow of government funds into our colleges and universities has been steadily growing, mostly for the procurement of research services with specific objectives—that is, for the procurement of applied research and development. Contracts for such work in large volume have been promoted by the defense agencies and the Atomic Energy Commission. The Office of Naval Research, the Atomic Energy Commission, the National Institutes of Health, and other agencies have also supported basic research, largely under contracts or other instruments which, to the extent to which it was legally possible, were so drawn that they were in effect grants-in-aid.

The Office of Naval Research tided over a threatened hiatus in the progress of basic research in colleges and universities by providing funds during the period when the legislative labor was bringing forth a new agency of the Federal Government to be responsible, among other things, for research and education in science. When the National Science Foundation emerged in 1950, it had wide latitude under its act, so that it could make grants for research without "practical" objectives, thereby to assist universities and colleges in meeting their responsibility to create new knowledge by supporting the scholars on their faculties. Thus, from the several agencies mentioned, the support for basic research has been rapidly increasing but in substantially smaller volume than that for applied research and development from all agencies.

A pattern becomes discernible in the flow of government funds to colleges and universities for research and development. It seems pertinent to explore something of its background. It is desirable to obtain a clear view of the responsibility of the government and the universities, respectively, in their support of basic research. It is equally important to discover, if possible, the effects of govern-

ment financing of all kinds of research and development projects, particularly the effects on universities of contracts with government agencies under which the institutions are called upon to perform stated services within a specified time.

Scholarly Research the Tradition

In this exploration, several interesting and relevant facts come into view. Prior to World War II, most research was done as an individual undertaking, usually by a scholar imbued with the spirit of inquiry, with whom graduate students and younger colleagues had close association. A university so comprised effectively disseminated knowledge through teaching and created knowledge through research. Both activities remain the traditional responsibility of the university. May we not assume that this model of a university continues to be a desirable one, notwithstanding that some of its scholarly resources may have to be directed into team research?

Somehow the scholars in such a community have always managed, even without funds earmarked for a project, to produce knowledge, to become renowned for scholarship, to attract graduate students from distant places, and to contribute substantially to the prestige of their institution. Somehow the university found ways and means of supporting their work. Private gifts and grants were sought and gladly accepted for its furtherance. No one doubted that such contributions helped materially in advancing knowledge. Government contracts had not yet entered the picture.

During the war, most of the scientists were drawn into military development work in science, engineering, and medicine, many by the military departments and the Manhattan Engineer District, and many more by the Office of Scientific Research and Development. Their work was on urgent projects and crash programs, not basic research. In these they soon learned the effectiveness of the "research team" with large sums of money at its disposal. The OSRD initiated the no-gain-no-loss contract with universities, under which all costs were paid, both direct and indirect. This was proper, since the contract called for specific services, some of which could not appreciably contribute to the educational aims of the institution and would certainly not have been selected by the scientists had they had complete freedom of choice. Moreover, it would have been contrary to any rules or expectations to have the university help the government to pay for the job. It was a case of rendering national service in time of great emergency.

Postwar Change in Pattern

With the war finished, the scientists were eager to resume their normal activities and did so as quickly as they could. The OSRD contracts and those of the military agencies had established many liaison arrangements between administrators and scientists in the institutions, on the one hand, and the agencies, on the other. The latter had continuing responsibility for the development of weapons, and defense and weapons systems, which made it desirable for them to continue their associations with the institutions. This was one way of easing the burdens on their own laboratories, and it was the simple, perhaps all-too-obvious, way of getting the scientists back quickly on military developments in the event of future war.

Accordingly, the government agencies continued contracts for many projects with the institutions and initiated new ones. However, there were many scientists who had had their fill of such work. They wanted no more secret projects, carried on behind locked doors, with results that they could not publish. Nor did they want to devote their time to finding practical applications of science; they wanted basic research. But they had become accustomed to large funds, easily acquired. Many now felt unable to pick up where they had left off, except with sums of money a few magnitudes greater than they had ever before had for their own work. And they felt the need of paid assistants, because the military jobs furnished them paid assistants. Many were convinced that team research was the new order, with management and organization set up on industrial lines, and that they should, as "principal investigator," manage the teams and the funds.

In their feeling of need for financial aid and their desire to initiate team work, they did not discriminate between the military developments on which they had worked and their own prewar basic research. The new pattern of large operations had been extended, in their minds, to include their own work. They would be greatly handicapped unless they had a great deal of money and many assistants. In many instances their university administrations were easily persuaded to adopt the same view. Institutions participating in war work had greatly, and in unaccustomed ways, expanded their operations but apparently found this to their liking and were loath to see reduction in activities and budgets.

It is not to be argued that more funds for basic research are not needed or that the team approach is not the way in which some basic problems must be tackled. We have impressive demonstrations of its merit in both the physical and the life sciences. However, the "ivory laboratory" with its tower for seclusion and contemplation still has an important place in the scheme of basic research. The most profound of new ideas are more likely to issue from the gifted individual with time and opportunity to think than from the large team. Indeed, without time and opportunity for contemplation, profound discoveries may not be made at all. The small grant-in-aid for the gifted individual still has great merit, but this does not preclude or prejudice the large grant for the large apparatus with its large team. Both kinds of grant are needed. If facilities and personnel required exceed the means of an institution or of an associated group, it is proper under existing conditions that the government assume whatever costs the institutions cannot afford, for research must go on. Nor—until something better can be done about it—does there seem to be an alternative to enlarging the flow of money from government to the college and university. If teaching and research are to continue as they must, the institutions need the money, and their need becomes more pressing each year, with more students.

Fiscal Dilemma

One who is sensitive to the financial needs of education, and is sympathetic with the presidents of universities and colleges in their very difficult quest for more operating funds, is inclined to take the view that "money is where you find it," and that any fair means of getting it must be adopted. The most obvious source appears to be government; hence, any legal device or method for getting money from this source should be used. One can find little fault with this position. Closer scrutiny, however, suggests that a question may be raised about it.

One may with good reason feel uneasy about an aspect of grants-in-aid from the government, or, for that matter, from any source, that appears not quite in keeping with the spirit and dignity of scholarly research. This is the assertion by some institutions that they cannot support the research of their faculties, even with grants-in-aid, unless the gift is accompanied by a supplementary gift to cover full overhead accountable to the research. Before government money was available, no one seems ever to have worried about overhead on the basic research of individual faculty members. It was part of normal running expenses. Their laboratories had been built, equipped, and provided with the usual services of light, heat, electricity, water, gas, and whatnot. It is doubtful too that reserves for depreciation and obsolescence were ever carried on the books. Now, if government or other donor

makes a grant to pay for research to be done in such a laboratory, the donor is expected also to pay the rent and other items comprising indirect costs, with alleged serious consequences if it is not done. Such a position seems to some to be not in harmony with the forthright statement of fundamental principles in the Hancher Report of the American Council on Education (*3*) that all accredited institutions of higher learning subscribe with varying emphases to three primary and essential aims, the first of which is "the extension of the boundaries of knowledge." An "essential aim" would seem to imply acceptance of responsibility for its accomplishment.

It is helpful in this discussion to keep in mind the essential difference between work done at government solicitation, comprising largely services procured under a contract, and the kind of research that a scholar prefers to do. Almost certainly no one would quarrel with payment of full costs, direct and indirect, for services procured under contract to accomplish a stated task. But when a gift is offered, in the form of a grant to assist in the research support of a faculty member, it would seem that its acceptance on the one hand, or its rejection, on the other, should settle the matter. When an amount of money is tendered to help an institution to carry out a responsibility, there is an implication of ill grace in "bargaining at arm's length" and saying to the grantor, "We appreciate your offer, but it isn't generous enough."

When an institution takes this position, there is a strong suggestion that it does not fully recognize or unreservedly acknowledge its responsibility for "extension of the boundaries of knowledge." We do not overlook the fact that it is national policy that the Federal Government promote and support basic research. This, however, ought not to result in disavowal by universities of their recognized responsibility to support their research function, just as they support their teaching function. The government it not "buying" knowledge through basic research; it is assisting the institution in meeting its traditional responsibility of increasing knowledge.

Government Money: Government Control

When an institution shifts increasing responsibility toward the Federal Government to pay for its research, it moves into hazardous territory—hazardous to its freedom. If there were substantial increases in subsidy, including all indirect costs, so that no outlay whatever would come from the university's regular budget to pay for a given research, this would constitute a step toward full subsidization of all the institution's research. How could intrusion or domination by government then be avoided? Even now, while government money pays for only a part of all research that faculty members want to do, there exists a measure of government control which, although not calculated, is becoming manifest in various ways and, through continuing and increasing practice, might easily become established policy.

To assure against misunderstanding, it should be made clear that my sympathies and interests have always been with the institutions of higher learning, especially with respect to their problems of balancing income and outgo. They have no choice but to exploit with forthright integrity every possibility of obtaining operating funds. The insistence by some of them upon ever-increasing overhead allowances on grants for basic research is symptomatic of deeper trouble than can be cured or even much alleviated by an artifice of bookkeeping. It is like taking aspirin to cure a deep-seated organic disease.

One possible escape from the unfortunate but inevitable difficulties in which the question of overhead on grants is imbedded comes to mind. It is not easy to prognosticate the direction and extent of a research undertaking, but the rate at which it proceeds is determined by the investigator's drive and by his duties and preoccupations; and the rate at which funds are needed can be approximately predicted. Thus a granting agency in consultation with a scientist can learn his plans and determine the approximate annual cost and the cost of equipment. Having reviewed the plan in the light of available funds and other pertinent factors, the agency would offer a sum to the scientist's institution to provide for financing the work for a given period.

It would also tender a supplementary grant, amounting to some stated fraction of the principal grant, in recognition of the fact that the institution has expenses that must be met, which in part arise out of its responsibility for supporting research scholars on its staff. For example, the supplementary grant might amount to 20 or 25 percent of salary items in the plan for the research and 10 percent of the cost of equipment. The primary grant would be used as intended, in its entirety, for the support of a particular piece of research. The supplementary grant would become part of the institution's "own funds," for which no accounting would be required.

Problems and Pitfalls

Inability to balance budgets easily takes on a further serious aspect in the financial relations between government and a university that develop in the widely used contract for procurement of technical services. When a university sees fit to assume the responsibilities imposed by such a contract, all disbursements by the university, both direct and indirect, assignable to the contract, should be covered by the contract. They should, in fact, be adequately covered, including any margin of uncertainty about what constitutes "cost." Here a subtle danger should be recognized.

Although such contracts are intended to be no-gain-no-loss, some universities have derived substantial benefit from them. They have in some cases become the financial mainstay of institutions that extended themselves, beyond their traditional functions, for the handling of such contracts. Since the portion of overhead funds not disbursed in the performance of the contract is uncommitted money, such funds can be and are used for purposes other than those shown in the tabulation of what constitutes overhead. Thus the task of obtaining general operating funds is made somewhat less arduous. This becomes a strong incentive to accept and even to seek contracts, with diminished critical appraisal of whether the work to be done contributes to the advancement of the institution in performing its primary obligations.

A cynic might suggest that integrity has suffered. He might surmise that at some institutions business considerations strongly influence, if they do not control, educational policy. Indeed, he might point out that even research scholars have fallen in with the idea of getting easy money from the government. And there are instances where an institution has put salaries on an incentive basis, the incentive being a salary boost contingent on the researcher's success in landing a government contract. If there has indeed been subversion of integrity, some of the money-dispensing agencies must share the blame, for there is an impression—perhaps with reason—that it is easier to get $50,000 or $100,000 than $5000 or $10,000.

Another danger—not always easily discernible—lies in the opportunity for a career-building staff member of great enterprise but perhaps lesser competence in science than that of his colleagues to use the successful promotion of government contracts as a promotional device for himself. Even a grant-in-aid may not be exempt from such designs.

Such misgivings as one may have in these matters may, to a degree, be resolved by referring again to the "Fundamental principles" of the Hancher Report. Here it is stated that, in addition to the research and teaching functions, universities have a public service function, to perform services other than teaching and research. In tax-supported

institutions, such as state universities, this is obligatory to a limited extent, whereas in private institutions it is voluntarily assumed. In either case, if the decision is to accept a contract, there is ground for criticism only if the work goes far beyond the traditional functions of institutions of learning, or if the institution is not obviously well qualified to undertake the assignment. When a contract is of such scope and size that a greatly increased staff has to be hired for management and operation, and if other than the financial interests of the institution are thereby not clearly served, the wisdom of accepting the contract is properly questionable.

The discussion in several preceding paragraphs relates to some of the consequences of the chronic lack of operating funds that is characteristic of higher education. If institutions had adequate resources for normal operation, they would be under no pressure to decide whether or not to engage in activities that are probably not of the kind in which universities should have to be engaged.

Some Searching Questions

A contract that puts an added burden of performance of unusual or unaccustomed functions on a university may have detrimental effects on the performance of its regular functions. This is a serious matter of which many administrations are aware. In this connection, some questions should be asked about other aspects of possible effects of contracts on the normal operations of the university or college.

Are the over-all excellence of teaching and the level of scholarly output increased or diminished?

How is the prescribed work related to the educational functions? Does it have unfavorable effects on departments not involved in the contract work, such as the classics and humanities? Is research in good balance in all fields of learning? Does the performance of the services require intellectual effort that presents a challenge to the best minds, or does it comprise essentially pedestrian invention and design, with production of a prototype device as evidence of performance? Could the work be done as well or better by some other organization or agency?

Does the contract require the employment of scientists and engineers at salaries competitive with those of industry, but lacking faculty appointment or status? Does it entail serious problems of administration by requiring two categories of employees of substantially equal competence but different status in salary, rank, and tenure?

Have faculty members with strong inclinations toward basic research been shunted into managerial or supervisory jobs? How have their research and teaching been affected? Have their normal duties been assigned to others of equal competence?

Have contracts lured graduate students from preferred intellectual pursuits and turned them into technicians employed for stated services? Have the contracts adversely affected their free choice of research problems? Have contracts contributed to the fullest scholarly development of which the students are capable?

Have standards for the awarding of advanced degrees been lowered so that work done by a student under the contract might be acceptable as his dissertation?

Has contract work had to be classified so that results, and particularly thesis work under a contract, could not be freely published?

Many other questions such as these could be asked. A searching inquiry of this kind will probably never be made, and this is regrettable (*4*). But observation of what is going on and examples of cases that occasionally appear give little ground for optimism. There can be little doubt that the course and quality of higher education, especially in the postgraduate areas of science and engineering, are being substantially influenced by large government funds. The observant, interested citizen must judge whether the results are beneficial or detrimental. A widespread view prevails that in the main they are detrimental; that the uncommitted funds derivable from contracts are an unduly powerful incentive to seek contracts; that the faculties of institutions have little voice in determining to what extent changes in scholarship requirements for their own academic community may be allowable because of the presence of contract activities; that the public benefit from the funds allocated to contracts is unknown and hard to measure but in some cases probably very small.

Possible Answers

If such detrimental effects exist, there is call for positive suggestions for improvement. Let the scholarly research in universities and colleges be supported to the greatest possible extent by gifts and grants which become the institution's "own money," derived from many private and some public sources. Let the research that requires large equipment and personnel be supported by grants and contracts under which the government pays all costs except those that the institutions can assume.

Let contracts proffered by a government agency be carefully scrutinized and judged in terms of contributions to the scholarship of an institution as well as to its finances. Let careful discretion be exercised in the acceptance of contracts for services, to make sure that there is no loss of freedom in educational and research policies or administration.

With the increasing pressure for federal aid to education the outlook is disquieting. There are implications of growing government control, a situation that can hardly be avoided with a rising flow of government funds into educational institutions. The threat is there. Countermeasures are difficult to devise and more difficult to apply, yet they must be found.

A suggestion in this direction has appeared and is being further explored and developed (*5*). Institutions must be provided with adequate, uncommitted funds, free from any possibility of control, coming in steadily year after year, commensurate with current needs. A simple change in the federal income tax laws can bring it about. It can produce a continuing and increasing supply of funds from millions of private donors, in addition to the already substantial gifts from corporations.

Once such a solution or a better one is in operation, it will relieve the presidents of institutions of the onerous burden of fund-raising, thus enabling them to devote time and effort to charting desirable courses for their institutions. The president may then become, as by tradition he is, the intellectual leader of a community of scholars. Then, as never before, can the institution be on its way, with complete self-determination and with confidence in its future, in its immeasurably important task of inspiring and developing keen minds to scholarship. Then only can the university or college aspire to be the cultural community through which the national character becomes truly revealed, and the foundations for the nation's welfare become firmly established.

References and Notes

1. The views expressed in this article are strictly my own. They are not to be construed as reflecting in any manner the official position of the National Science Foundation. Indeed, they are at variance with one aspect of foundation policy; but I feel certain that there is a substantial body of opinion which I am here trying to express and which in my view should be stated.
2. A. Stern, *Am. Scientist* 44, 281 (1956).
3. Report of the Committee on Institutional Research, American Council of Education (1954).
4. The National Science Board has a Committee on Government-University Relationships to advise the foundation with respect to policies of government agencies in the support of research at universities and colleges.
5. P. E. Klopsteg, *Science* 121, 781 (1955).

On Biochemical Origins and Optical Activity

Sidney W. Fox, Joseph E. Johnson, Allen Vegotsky

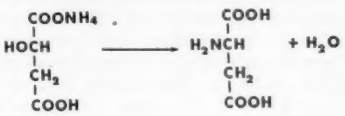
Attempts to explain the origin of the biochemical world often rest on such reactions as those of formaldehyde and ammonia (*1*), the high-energy radiation of aqueous carbon dioxide (*2*), electric discharge through presumably primitive gases (*3*), reactions of cyano compounds (*4*), and thermal reactions (*5*) that were unintentionally uncovered in experiments designed to explain the primordial origin of protein (*6*).

Simple heat in the range of 100° to 200°C has been shown to be sufficient to imitate a number of early steps in the pathways of biosynthesis. Ammonium hydrogen malate is converted by purely thermal means into aspartic acid (*5*), α-alanine (*5*), β-alanine (*7*), and polymers from which such amino acids may be recovered after hydrolysis (*5*). Preliminary indications, such as positive biuret tests, have been obtained for the presence of peptides in the polymers and of thermal conversion of the identified amino acids to yet others. Evidence that polymers formed by thermal treatment of unsubstituted aspartic acid are, at least in part, linear peptides has also been provided (*8*).

The presumption that the thermal reactions imitate prebiological chemistry is supported by the deduction that the most primitive algae are thermophilic (*9*) (the fossils of the most primitive organisms being algal, *10*), by the inference that the current biochemical world is not greatly different from the primordial biochemical world (*11*), and by additional evidence from thermal experiments, as described here. The thermal emphasis is in accord with the estimates of terrestrial temperature of billions of years ago (*12*). Furthermore, a temperature above the boiling point of water (varying, of course, with the prevailing pressure) might make it possible to explain the overcoming of the thermodynamic infeasibility (*13*) of forming the first, or any other, peptide bonds by removal of water.

$$H_2NCHRCOOH + H_2NCHR'COOH \rightarrow H_2NCHRCONHCHR'COOH + H_2O \uparrow$$

These considerations, in fact, led to the first thermal experiments in this program (*14*). This paper describes the finding of ureidosuccinic acid as a product f reaction and also presents new considerations of the origin of optical activity. The conversion of ammonium hydrogen malate to aspartic acid has been studied



for a range of time and temperature (Table 1).

The results indicate a ceiling yield of aspartic acid of approximately 40 percent in a range of 140° to 200°C for 1 to 4 hours. The ammonium hydrogen malate was prepared from L-malic acid and concentrated ammonium hydroxide in 95-percent ethanol, from which it precipitated immediately (melting point, 159° to 160°C) (*15*). The salt was heated in an open test tube in an oil bath and cooled; the viscous product was dissolved in excess 6*N* hydrochloric acid, and the mixture was hydrolyzed at 15 lb of steam pressure in an autoclave for 16 hours. The product was treated with sodium acetate and converted to copper aspartate and thence to aspartic acid (*16*), which was examined for optical activity. Except for a small proportion of optical activity found in a preliminary experiment, the products were devoid of optical activity. Racemization had, therefore, occurred under these conditions.

Accordingly, it became of interest to determine whether the conversion of malate to aspartate could be effected through a reaction other than that requiring the ammonium salt. A faster mode of reaction might enable the conversion to proceed at a temperature sufficiently lower to preclude racemization. For this purpose, urea in admixture with malic acid was employed instead of ammonium hydrogen malate. A more compelling reason for the use of urea was the fact that it represents the urea cycle (*17*), which appears to function in autotrophic organisms as a mode of synthesis of arginine (*18*) and perhaps of other biosynthetic intermediates as well. The simultaneous employment of intermediates from the tricarboxylic acid cycle and the urea cycle in a thermal experiment might thus be expected more closely to imitate prebiological chemistry. Results of a number of experiments indicated that aspartic acid or its derivatives or both were indeed formed at temperatures such as 100° and 120°C in appreciable amounts when urea was a reactant with malic acid. Melting point and chromatographic evidence from paper and Dowex-1 columns, however, suggested that ureidosuccinic acid was also formed. Although this result was not consistently reproduced, the finding led to experiments in producing ureidosuccinic acid under conditions which enter the purview of this project.

Formation of Ureidosuccinic Acid

Ureidosuccinic acid has been prepared by Lippich (*19*) by heating aspartic acid in the presence of a mixture of urea and barium hydroxide in water. It was now of interest to ascertain whether this synthesis could be accomplished with calcium hydroxide instead of barium hydroxide. Many of the "primitive" blue-green algae are known to thrive under calcareous conditions (*9*). Any comprehensive theory of biochemical origins must therefore explain the introduction of calcium, which is found abundantly throughout phylogeny. On the basis that the ultimate biological ancestors were thermal aquatic types (*9*), it is also pertinent to study reactions simulating biochemistry in a hot aqueous environment. If some of prebiological chemistry was essentially nonaqueous and, therefore, favored peptide-bond formation, modulation to an aqueous system must also be understood.

Magnesium oxide was also tested on the basis that magnesium ion is a cofactor in ureidosuccinic acid metabolism (*20*). Experiments were also performed with potassium hydroxide. The results with these bases are presented in Table 2. The *p*H ranges for calcium and magnesium overlapped the range in which some thermal blue-green algae are known to thrive—namely 2.8 to 9.1 (*9*).

Because of the greater reproducibility of synthesis in aqueous systems it was also of interest to study the effect of variation in the proportion of water. The results are presented in Fig. 1.

The synthesis of ureidosuccinic acid from aspartic acid was far more readily reproducible in aqueous solution than in dry heating of the mixture of malic acid and urea. Table 2 reveals a much lower yield in the absence of base than in its

Dr. Fox and Dr. Vegotsky are with the Oceanographic Institute, Florida State University, Tallahassee, and Dr. Johnson is at the Massachusetts Institute of Technology, Cambridge.

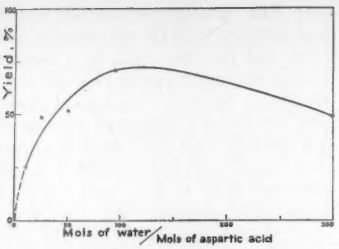


Fig. 1. Variation in yield of ureidosuccinic acid with variation in proportion of water.

presence. This is undoubtedly the main cause of the difference.

Optical Activity in Nature

The origin of the large degree of configurational uniqueness in hydroxy acids, carbohydrates, amino acids (*21*), and other substances in nature might be better understood as arising from a single molecular structure which happened to be of one optical type. In this manner, L-malate might be expected to yield L-aspartate, and other amino acids produced from a single L form by thermal conversion could be expected also to be of the L configuration. In the conditions studied so far in the experiments reported, racemization was the principal result, and it is appropriate therefore to consider other possibilities. These evaluations rely particularly on the concept of spontaneous resolution. A type of spontaneous resolution is the chance mechanical separation of a crystal of one optical type to a key intermediate (*22*).

The phenomenon of spontaneous crystalization favoring one optical form was reported by Pasteur (*23*) with the compound of prime interest in the present work, ammonium hydrogen malate. This observation of Pasteur was confirmed by van't Hoff and Dawson (*24*), and a similar behavior from melted ammonium hydrogen malate was disclosed by Kenrick (*15*). These and other cases are discussed by Greenstein (*25*). Partial resolution by seeding has also recently been reported for threonine (*26;* see also Havinga, *27*).

The biological facts indicate that some microorganisms that are relatively low on the phylogenetic scale are rich in D amino acids (*28*), whereas the D form is all but unknown in higher organisms. In addition, the puzzling occurrence of D-amino acid oxidase in mammals (*29*) can be explained as a chemical evolutionary vestige (*30*), inasmuch as the lower forms do contain D-amino acid residues. In the early stages of evolution, the spontaneous appearance of one key intermediate in a single configuration should trigger configurational one-sidedness through an entire biosynthetic chain. For example, ammonium hydrogen D-malate (*22, 23*) might spontaneously crystallize from a primitive, natural nutrient medium, and the L form left in solution would then yield L conversion products such as L-aspartic acid and L-alanine (*31*). Enzymes composed of L-amino acid residues would be expected to have a selective advantage (*32, 33*). The theoretical expectation that any statistical number of racemic molecules will contain at least a few of one enantiomorph in excess of the other (*27*) could also lead to configurational unity by Darwinian selection through the uncounted generations of evolution (*32*).

Whether a preponderance of one enantiomorph of any key biochemical substance may have arisen gradually or suddenly, it would be unnecessary for this phenomenon to have occurred in the prebiological era, and it would be more probable, for the reasons given, that it appeared in the biological era.

Table 1. Weights (g) of aspartic acid from 5.0-g lots of ammonium hydrogen L-malate over a range of time and temperature. The aspartic acid was obtained by heating ammonium hydrogen malate after hydrolysis of the product.

Temperature (°C)	Time (hr)		
	1	2	4
140			0.7
160	0.6	1.3	1.7
180	2.1	2.1	1.7
200	2.2	2.2	2.1

Table 2. Yields of ureidosuccinic acid from aspartic acid and urea with each of four bases in hot water.

Base	Yield (%)	Melting point (°C)	Initial *p*H	Final *p*H
$Ba(OH)_2 \cdot 8H_2O$	57	178–1/2–180	12.9	9.7
$Ca(OH)_2$	47	181	9.0	9.8
MgO	46	178	8.2	9.8
KOH	80	178	12.8	10.1
None	5	164–6		

Conclusions

The finding of ureidosuccinic acid as a principal product of the thermal reaction of malic acid and urea under hot-springs conditions is pertinent to the origins of biological chemistry in that ureidosuccinic acid has been shown in recent years to be a key intermediate in the biosynthesis of nucleic acids (*34*).

The accumulated data reveal a thermal pathway as shown in Fig. 2. These reactions, with some minor modification, represent also some of the early steps in biosynthesis. Many inferences may be drawn from these relationships (*35*).

Considerations of the primordial origins of the biochemical world are necessarily subject to a long process of variation and retesting before they are fully acceptable. Justification of such activity lies in the possibility that it "limits the range of speculation," as expressed by Rubey (*3*) in a discussion of the origin of the biogeochemical world. It can be expected that the limits of speculation on the origin of the biochemical world may be set most accurately by the framework of dynamic biochemistry and a back-extrapolation of biological evolution, as is contemplated elsewhere (*35*).

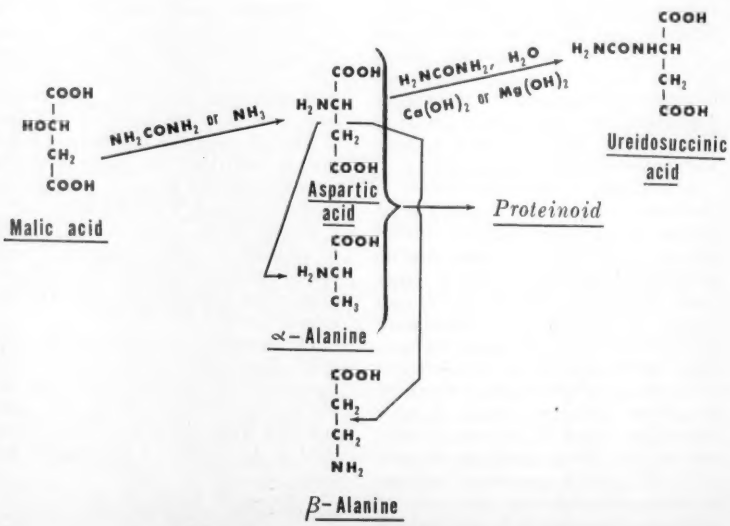


Fig. 2. Pathway of thermal synthesis (biosynthesis).

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News of Science

Nuclear Weapons Tests

A recent statement emanating from the National Academy of Sciences that nuclear test explosions could be increased tenfold "without causing any serious genetic danger" has resulted in the publication (*Washington Post,* 26 Oct.) of the following letter from A. H. Sturtevant of California Institute of Technology.

"I have just seen the news item in your issue of Oct. 15, headed 'Tenfold Rise in A-Tests Seen as Safe.'

"This account implies that the National Academy of Sciences Committee on the Genetic Effects of Radiation concluded that a tenfold increase in fallout would not be serious.

"As a member of that committee I wish to state that the report of the committee reaches no such conclusion, and that I, for one, would have been unwilling to sign a report that could reasonably have been so interpreted.

"Further, since the committee reported, Commissioner Libby has indicated (Oct. 12) that the danger from radioactive strontium in fallout is greater than the information available to the committee led us to suppose. For this reason, our conclusions about the danger from fallout need revision upward."

In recent weeks other statements by scientists about the testing of hydrogen bombs have appeared in the press:

Bentley Glass of Johns Hopkins University, who like Sturtevant was a member of the NAS Committee on the Genetic Effects of Radiation, cautioned that uncontrolled testing of nuclear weapons could become a genetic threat through competitive snowballing. Glass proposed an international agreement on the number of nuclear explosions allowed to each nation, as a needed safeguard for the protection of the human race (*Washington Post,* 17 Oct.).

In supporting the proposal to discontinue large nuclear tests, ten scientists at California Institute of Technology said: "It appears to us that this might be a useful way to get the negotiations [on nuclear arms restrictions] out of the deadlock stage by taking a step that would not endanger our security" (Associated Press, 14 Oct.).

Later (Associated Press, 21 Oct.), 73 scientists at Argonne National Laboratory added their signatures to the C.I.T. declaration.

In contrast, five others said: "As citizens, we wish to express our approval of the test program as handled to date" (*New York Times,* 22 Oct.).

Lee A. DuBridge, president of C.I.T., followed his colleagues' endorsement of a test ban with the observation that from "my own official Government contacts, I have become convinced [that] large-scale tests are an important part of our weapons-research program. . . . Discontinuance [of such tests] should . . . not precede enforceable international agreements" (Associated Press, 15 Oct.).

Thirty-seven faculty members of the City College of New York, including 14 scientists, "warmly endorsed" the test ban proposal (*New York Times,* 19 Oct.).

Describing the outlook as "alarming," 24 scientists at Washington University in St. Louis commented that the nation's atomic policy has been made "in a vacuum of public information." They urged "intensive scientific study and public discussion" (Associated Press, 18 Oct.).

However, Arthur H. Compton, also of Washington University, and one of the principal figures in the development of the A-bomb, has stated that continued H-bomb tests are necessary "to maintain our freedom" (*Christian Science Monitor,* 25 Oct.).

Eleven members of the physics department at Columbia University, including Nobel laureate Polykarp Kusch, added their support to the proposed ban on tests and urged the President to join in the "clarification of public thinking on this crucial issue" (*New York Times,* 17 Oct.).

Nineteen members of the Atomic En-

ergy Commission research project at the University of Rochester Medical Center, including William F. Neuman, have described President Eisenhower's defense of further H-bomb tests as "confused" and an "oversimplification" of facts on fallout. They stated that "The National Academy of Sciences' Report does not say that the levels likely to be reached, if bomb testing continues, are safe. . . . There is good reason to fear that they may not be safe" (*Washington Post,* 26 Oct.).

Shields Warren, former AEC medical research chief, supports continued tests, as do 12 well-known scientists whose names were released in a memorandum from the chairman of the AEC to the President.

On 24 Oct., the Federation of American Scientists, a nation-wide organization of more than 2100 scientists and engineers, reiterated its earlier support for an international agreement to a ban on tests of large-scale nuclear weapons. A statement was released by the FAS executive committee, which is made up of the following members: Charles C. Price, head of the chemistry department at the University of Pennsylvania; Martin Deutsch, physics professor at Massachusetts Institute of Technology; Harry Palevsky, physicist at Brookhaven National Laboratory; Mortimer M. Elkind, biophysicist for the National Institutes of Health; John T. Edsall, professor of biochemistry at Harvard University; Donald J. Hughes, senior physicist at Brookhaven National Laboratory; and Bruno H. Zimm, research chemist for the General Electric Research Laboratory.

On 26 Oct., 200 scientists endorsed the President's "leadership and program" in a statement that was released by Roger Adams, chairman of the science branch of the Committee of the Arts and Sciences for Eisenhower (*New York Times,* 27 Oct.).

On the following day, 22 scientists, including 18 at the Worcester Foundation for Experimental Biology, Shrewsbury, Mass., issued a statement declaring that the possible danger in hydrogen bomb tests was "a real problem which must be faced and should be discussed openly." The signers of the statement included two professors at Clark University and two members of the staff of the Worcester State Hospital (Associated Press, 27 Oct.).

Controlled Burning of Combustible Materials

The National Bureau of Standards has developed a simple, rapid method for burning combustible materials under closely controlled conditions. With this procedure and equipment, the gaseous products formed when organic materials are burned in air can readily be collected and analyzed. The results give a quantitative estimate of the combustion gases produced from such organic coatings as paints, asphalts, and plastic compounds. This information is useful in selecting organic coatings with particular thermal breakdown properties for use in buildings and other structures. The method was developed by A. Schriesheim, of the bureau's floor, roof, and wall coverings laboratories, working under the sponsorship of the Air Force.

The principal combustion products of organic materials are carbon monoxide, carbon dioxide, and water. When organic materials contain other elements in addition to carbon, hydrogen, and oxygen, combustion yields other gases as well. Among these are ammonia from wool, cyanogen from silk, sulfur compounds from rubber, and chlorine compounds from chlorinated plastics. To generate, collect, and analyze combustion products, earlier investigators burned large, built-up specimens, including actual rooms and buildings. Subsequently, laboratory procedures were developed to replace such costly and time-consuming processes, but these methods were slow and of doubtful accuracy. The bureau's recently developed method of burning organic materials provides a quick and comprehensive analysis of the gases as well as close control of the ratio between air volume and specimen weight at any initial firing temperature up to 550°C.

The bureau's equipment for burning organic materials consists essentially of a combustion chamber containing a heating element for firing the specimen, and apparatus to control the amount of air in the chamber. The combustion chamber, a 2-liter pyrex flask, can be tilted so that the specimen will slide down a silica tube inside the flask into the heating element.

In use, a porcelain boat containing the specimen is placed in the silica tube as far from the platinum heating coil as possible. After the combustion chamber is evacuated through the vacuum system, a controlled amount of air is admitted to the chamber. A constant ratio of specimen weight to amount of air is maintained by adjusting the specimen weight when combustion is initiated at higher temperatures.

Current is applied to the platinum coil until the desired firing temperature is reached. The combustion chamber is inclined, the boat containing the specimen slides down the silica tube into the hot platinum coil, and the material begins burning. After the temperature has been held constant for the appropriate time, the current is turned off and the apparatus cools to room temperature. The combustion gases are now available for analysis in a mass spectrometer.

In a series of investigations performed with this equipment, the results showed that for every material examined the greatest variety of gases was produced at the highest initial firing temperature (550°C). At this temperature, cracking and decomposition occurred and small molecular fragments such as methane and hydrogen were formed from many of the specimens. Chlorinated plastics liberated chlorinated compounds at the higher temperatures, while at the lowest firing temperature the only chlorinated material produced was hydrogen chloride. In every case the amount of hydrogen chloride increased with increasing temperature.

Several plywood assemblies, both painted and unpainted, and a polyvinyl chloride coating were fired in quantities sufficient to consume all the oxygen in the combustion chamber if they had been left to burn entirely to carbon dioxide and water. These materials produced the largest concentration of combustion gases, and caused the greatest decrease in the oxygen concentration. This low oxygen concentration is typical not only of the closed system used here but also of large, open, ventilated systems such as burning rooms and buildings.

Anterior Pituitary Hormones Available

The Endocrinology Study Section of the National Institutes of Health, Bethesda 14, Md., has announced a plan for supplying anterior pituitary hormones, other than ACTH, to qualified investigators in the medical sciences. Five of the NIH institutes are jointly providing the funds for the purchase or production of large uniform lots of the hormones, purified to meet exacting specifications, both for potency and for low limits of contamination with other activities.

The first lots of bovine growth hormone and of ovine prolactin have been approved by the study section and are ready for distribution. The growth hormone and prolactin are packaged as sterile, lyophilized powders in vials of 50 milligrams and 25 milligrams, respectively. Data on the estimated potency and degree of contamination and instructions for dissolving the materials will be issued with each package.

A pilot plant at Emory University is being set up under the direction of Stanley Ellis and Alfred E. Wilhelmi for the production of follicle-stimulating, luteinizing, and thyrotrophic hormones. These materials will not be ready for some months.

Details of the program are being looked after by a subcommittee of present and past members of the study section: Warren O. Nelson, Roy Hertz, Robert W. Bates, and Alfred E. Wil-

helmi (chairman). Gregory Pincus is chairman of the study section and Sam R. Hall is its executive secretary.

Grants of the hormones will be made to qualified investigators who apply to the study section. Application should be made in a letter that describes the proposed work and provides an estimate of the amount of hormones required. Requests will be granted to the extent that supplies allow.

It is hoped that by this service both clinical and fundamental studies on the anterior pituitary hormones will be stimulated. At the same time, it is thought that much advantage will be gained from the fact that a large number and variety of studies may be made by numerous investigators, all using the same highly purified and carefully tested preparations. Continuing support for the program will be sought if, as is thought by the study section, work in these fields has been limited by the availability of suitable materials.

New Planned Parenthood Research Committee

A biological research committee has been established by the Planned Parenthood Federation of America to lead a "concerted program" of research for improved methods of birth control and of infertility therapy. The committee, composed of 13 leading scientists in the fields of biology, physiology, biochemistry, medicine and population, is headed by Carl G. Hartman, formerly the director of Ortho Research Foundation in Raritan, N.J.

Establishment of the committee is an outgrowth of a conference on the physiology of reproduction sponsored jointly last spring by PPFA and the Population Council. At that conference it became clear, according to Hartman, that "despite tremendous gaps in our knowledge, there does exist a sufficient base of information to justify concerted efforts to solve the known problems in this field." He pointed out that increased knowledge of research in human reproduction would not only lead to better methods of contraception, but would also aid the 10 percent of American married couples who are involuntarily childless.

Relics of Ancient Culture in Japan

Hokkaido University has announced discovery of relics from the earliest culture yet found in Japan. The discoveries were made by an expedition from Hokkaido University and the Institute of Regional Exploration, Ann Arbor, Mich. T. P. Bank, American Fulbright scholar from Michigan, and Sakuzaemon Kokama of Hokkaido were coleaders.

The artifacts—mainly obsidian and stone blades, scrapers, and hand axes—were imbedded in a thick water-deposited terrace that is more than 10,000 years old. The terrace is located near the Sea of Okhotsk coast of Hokkaido, Japan's northernmost island. The expedition has discontinued work but will resume exploration next year.

U.N. Technical Assistance Pledges

As a result of the seventh Technical Assistance Pledging Conference held at United Nations Headquarters in October, a total of $30,295,000 will be made available by 65 governments toward the 1957 operations of the expanded program of technical assistance. This represents the largest sum yet provided for 1 year and exceeds by more than $2 million the funds pledged at last year's conference.

As in the past, several governments announced that they would make their pledges known at a later date; others assured the conference that their contributions would be at least at the level of their 1956 support, but might be increased in the next few months. The government of the United States announced a maximum contribution of $15.5 million of which $14 million would be paid to match the first $14 million of pledges from other governments; the balance of $1.5 million would be contributed at a reduced matching percentage to be announced later.

Three countries—Albania, Morocco, and the Sudan—made pledges to the Technical Assistance Fund for the first time, and Honduras renewed support that had lapsed in 1956. Nineteen other countries increased the amount of their pledges over 1956, accounting for an additional $750,000. Argentina, Bolivia, Finland, Greece, Hungary, Spain, Syria, and Switzerland all raised their contributions by 50 percent or more.

News Briefs

■ The Brooklyn Botanic Garden has obtained a 223-acre tract of woodland at Kitchawan, N.Y., adjacent to Croton Reservoir, which it will use as a field station for research. Gifts for the purchase and development of the station already have reached nearly $150,000. The garden is seeking to raise $250,000, which would include a partial endowment fund.

■ A 38-acre site in Oak Ridge, Tenn., has been sold to the Oak Ridge Institute of Nuclear Studies to provide space for six new permanent buildings. The new construction is expected to cost $3.5 million.

Scientists in the News

DICKINSON W. RICHARDS, JR., director of Columbia University's medical division at Bellevue Hospital, ANDRE F. COURNAND, professor of medicine at Columbia, and WERNER FORSSMANN, practicing physician of Bad Kreuznach in Western Germany, will share the 1956 Nobel prize for medicine and physiology, which this year amounts to $38,683.59. The recipients are being honored for their discoveries concerning heart catheterization and pathological changes in the circulatory system. The official citation reads: "[Their] investigations have meant that diagnosis can now be made earlier and with greater certainty than before. In this way, the prospects of preventing further deterioration are increased."

Behind the award is the story of a line of inquiry that began 27 years ago when Forssmann introduced a catheter tube into a vein of his right arm. Sitting behind a fluoroscope and watching a large mirror, he pushed the tube gradually into the right ventricle of his heart and then had x-ray pictures made. This ended the investigation for several years until a paper on his findings came to the attention of the two men at Columbia. They took up the research where Forssmann had left off.

ROBERT F. MEHL, director of the metals research laboratory and head of metallurgical engineering at Carnegie Institute of Technology, was presented with the Grand Medal of Le Chatalier by the council of the French Society of Metallurgy at its recent annual meetings in Paris, France.

I. S. RAVDIN, who holds the John Rhea Barton professorship of surgery at the University of Pennsylvania, was retired from service in the U.S. Army Reserve, Medical Corps, in ceremonies that took place at the university on 30 Oct. Ravdin is the first medical officer to reach the rank of major general in the Army Reserve Corps. His retirement ceremony was attended by ranking officers from Philadelphia and Washington and from the Second Army Command Headquarters, Fort George G. Meade, Md. Gaylord P. Harnwell, president of the university, spoke on the program.

H. MAX HOUTCHENS has been named chief of the Veterans Administration clinical psychology division in the central office at Washington, D.C. He succeeds H. M. HILDRETH, who has accepted an appointment with the Public Health Service. Previously Houtchens has served as chief consulting psychologist to VA's clinical psychology division in the psychiatry and neurology service in Washington.

HOWARD T. KARSNER, research adviser to the Surgeon General of the U.S. Navy and emeritus professor of pathology at Western Reserve University, will present the first Carl V. Weller lecture of the Michigan Pathological Society. He will speak at the University of Michigan on 8 Dec. on the "Place of pathology in biomedical research."

CHARLES M. LANDMESSER, since 1949 a member of the department of anesthesiology at Albany Medical College and anesthesiologist-in-chief to Albany Hospital, has been named chairman of the college's anesthesiology department. He succeeds J. GERARD CONVERSE, who has resigned to accept a similar position at the University of Miami, Coral Gables, Fla.

EDWARD W. DEMPSEY, chairman of the department of anatomy at Washington University School of Medicine (St. Louis), has been named assistant to the dean of the school of medicine. He will retain his position in the department of anatomy.

HAROLD F. RICHARDS, former head of the physics department and professor of physics at Florida State University, Tallahassee, has retired after 31 years of service on the university's faculty.

M. M. WINTROBE, head of the department of medicine at the University of Utah, is making a lecture tour of the Orient.

WILLIAM A. J. CRANE, lecturer in pathology at the University of Glasgow, Glasgow, Scotland, has joined the staff of the Ben May Laboratory of Cancer Research at the University of Chicago.

MARION A. BLANKENHORN, who retired recently as Taylor professor of medicine and director of the department of internal medicine at the University of Cincinnati, has been appointed director of education in the department of internal medicine at the Jewish Hospital, Cincinnati, Ohio.

H. SIDNEY NEWCOMER has assumed the position of medical director of the New Drug Institute, New York. He will supervise the grants for clinical research and evaluation handled by the institute, both for new drug applications and for determination of therapeutic efficacy. Newcomer, a specialist in the appraisal of new drugs and their introduction to the medical profession, is perhaps best known for his introduction of curare as a relaxant. The New Drug Institute provides guidance and research services to drug manufacturers in the development of new and improved products.

MARY JENNEY, a senior nurse officer in the U.S. Public Health Service Commissioned Corps, has been appointed chief nurse consultant to the new USPHS Professional Nurse Traineeship Program, the first federal program to further education of qualified graduate nurses in supervision, teaching, and administration. In the first 2 months of this program, nearly all of the 56 participating institutions have requested funds to enable nurses to prepare for leadership positions.

The Franklin Institute honored ten scientists at its recent annual Medal Day ceremonies. The Franklin medal, the institute's highest award, went this year to an aeronautical engineer, SIR FRANK WHITTLE, air commodore of Devonshire, England. The award is presented annually to a worker in physical science or technology. Sir Frank, a mechanical engineering specialist, was honored for pioneering developments in aircraft engines that have "revolutionized high-speed flight." The other medalists follow.

KENNETH BULLINGTON, a member of the systems engineering department of the Bell Telephone Laboratories, New York, received the Stuart Ballantine medal, for "advancement of space communications by means of beyond the horizon tropospheric wave propagation."

ROBERT G. LETOURNEAU of Longview, Tex., president of R. G. LeTourneau, Inc., manufacturer of heavy construction equipment, received the Frank P. Brown medal "for his revolutionary improvements in earth-moving equipment with vast benefits to public works and private building construction."

FLOYD A. FIRESTONE, physicist, inventor, and educator of Dobbs Ferry, N.Y., received the Edward Longstreth medal "for his invention and development of a practical industrial tool for the detection and measurement of the location and extent of defects in metal parts by ultrasonic means."

EDWIN H. LAND, chairman of the Polaroid Corporation, Cambridge, Mass., received the Howard N. Pots medal for "ingenious development of a practical hand camera and a process to expose and develop the negative and create a good positive simultaneously."

Five research mathematicians from the University of Michigan and Stanford University received the Louis E. Levy medal "in recognition of their paper 'The Folded Tree' appearing in the July and August, 1955 issues of the *Journal of the Franklin Institute*." They are ARTHUR W. BURKS, CARL H. POLLMAR, DON W. WARREN, and JESSE B. WRIGHT, all of the University of Michigan, and ROBERT McNAUGHTON of Stanford University.

GEORGE F. REDDISH, professor of microbiology and public health at the St. Louis (Mo.) College of Pharmacy and Allied Sciences, will receive the 1956 achievement award of the Chemical Specialties Manufacturers' Association for technical contributions in the fields of public health, disinfection, and antisepsis. The award, fifth of its kind to be made by the CSMA, will be presented to Reddish on 4 Dec. during the association's 43rd annual meeting in Washington, D.C. Reddish is editor of *Antiseptics, Disinfectants, Fungicides, and Chemical and Physical Sterilization*, a compilation of technical data in the disinfectant field.

The University of Maryland physics department has announced the following appointments.

WILLIAM F. HORNYAK, formerly research physicist at Brookhaven National Laboratory, has been named associate professor and is heading the department's new program in experimental nuclear physics.

FRIEDRICH H. HUND, director of the Institute of Theoretical Physics at the University of Frankfort (Germany), is a visiting professor for the fall term.

JOHN C. WARD, formerly of the Institute for Advanced Study, Princeton, N.J., and at present physicist for Varian Associates, Palo Alto, Calif., is visiting research professor.

ANTOINE VISCONTI, member of the Institute Henri Poincaré (France) is visiting lecturer. For the last 3 years he has been the representative for France in the CERN theoretical study group at the Institute of Theoretical Physics in Copenhagen (Denmark).

SIDNEY A. SIMMONS, for the past 6 years plant science editor for G. and C. Merriam Company, publishers of *Webster's New International Dictionary*, has resigned to take a position as technical editor with the General Electric Corporation in West Lynn, Mass.

Recent Deaths

LAWRENCE D. BELL, Buffalo, N.Y.; 62; founder and board chairman of the Bell Aircraft Corporation; 20 Oct.

TRUMAN L. BOYES, New York, N.Y.; 58; clinical professor of ophthalmology at the Post-Graduate Medical School of New York University–Bellevue Medical Center; 17 Oct.

VAN A. H. CORNELL, New York, N.Y.; 79; former head of the department of dermatology and syphilology at the New York Medical College; 24 Oct.

ANNA B. GALLUP, Mystic, Conn.; 84; retired curator-in-chief of the Brooklyn Children's Museum; 21 Oct.

THOMAS H. KEARNEY, San Fran-

cisco, Calif.; 82; retired agriculture physiologist with the U.S. Department of Agriculture; 19 Oct.

HENRY N. RIDLEY, London, England; 100; former director of Singapore's Botanic Gardens; originator of Malaya's rubber industry; 24 Oct.

DANIEL C. SAYRE, Princeton, N.J.; 53; associate dean of Princeton University's School of Engineering and director of the James Forrestal Research Center; 19 Oct.

ROY S. SWINTON, Ann Arbor, Mich.; 70; professor on the engineering mechanics faculty at the University of Michigan; 20 Oct.

GEORGE B. WISLOCKI, Milton, Mass.; 64; head of the department of anatomy, James Stillman professor of comparative anatomy, Hersey professor of anatomy, and a member of the faculty of the Harvard University Museum of Comparative Zoology; 22 Oct.

Education

■ The 36th annual observance of American Education Week is scheduled for 11–17 Nov. The purpose of the observance is to bring the needs and achievements of the schools before the public and to emphasize the important role education plays in democracy. National sponsors of American Education Week are the National Education Association, the American Legion, the U.S. Office of Education, and the National Congress of Parents and Teachers.

■ *Our Mr. Sun,* the first of a series of hour-long color films on science being sponsored by the Bell Telephone System, will be telecast on 19 Nov. at 10 P.M. over the C.B.S. television network. The aim of the programs is to present authentic scientific information in terms that will interest and entertain a mass popular audience. The films will be made available by the Bell System for showing to special audiences after their initial telecast. It is hoped that they will be useful in schools to stimulate interest in science or as teaching aids in specific fields.

General supervision of the choice and treatment of subject matter for the program series is in the hands of an advisory board that includes the following members: George W. Beadle, California Institute of Technology, biology and genetics; John Z. Bowers, University of Wisconsin Medical School, medicine; Paul R. Burkholder, Brooklyn Botanic Garden, microbiology and bacteriology; Farrington Daniels, University of Wisconsin, chemistry; Maurice Ewing, Columbia University, earth sciences; George R. Harrison, Massachusetts Institute of Technology, physics; Clyde Kluckhohn, Harvard University, anthropology; Warren Weaver, Rockefeller Foundation, mathematics (vice chairman); and Ralph Bown, former vice president of research, Bell Telephone Laboratories, engineering (chairman).

In order to achieve the broadest popular appeal, the programs will make full use of entertainment techniques. These will include "story" plots, animated cartoons, and documentary photography from remote areas of the world. Scientific films, such as microphotography and time-lapse sequences, also will be used. Frank Capra is producer and director of *Our Mr. Sun.*

■ The staff of a laboratory at Harvard Medical School and Boston Lying-In Hospital is working for 4 months at the Karolinska Institute Hospital in Stockholm, Sweden. Five biological chemists, led by Claude A. Villee of Harvard, will expand their current studies on changes taking place in embryonic tissue prior to birth in association with the Karolinska staff. Working in Sweden with Villee will be his wife Dorothy, also a scientist, and D. D. Hagerman, J. M. Loring, and F. M. Wellington.

■ The Educational Television and Radio Center, Ann Arbor, Mich., has prepared three new films designed to encourage interest in the area of science. They are *Tempest in a Test Tube, The Secret of Flight,* and *Doctors of Space.*

■ Exercises inaugurating a graduate educational program leading to the Ph.D. degree in the biological sciences basic to medicine took place recently at the State University of New York's Downstate Medical Center in Brooklyn. The new program, which this year admitted candidates to the study of anatomy, biochemistry, pharmacology, and physiology, will complement the Medical Center's 4-year program leading to the M.D. degree.

Grants, Fellowships, and Awards

■ During October, colleges and universities in the United States, Cuba, and Hawaii received $196,383 in grants from the Research Corporation to aid basic research in science. The awards, which are distributed quarterly, will aid investigations in chemistry, physics, astronomy, mathematics, and engineering. A total of $630,551 has been distributed so far this year.

■ The School of Mathematics of the Institute for Advanced Study, Princeton, N.J., will allocate a small number of grants-in-aid to gifted young mathematicians and theoretical physicists to enable them to study and to do research work at Princeton during the academic year 1957–58. Candidates must have given evidence of ability in research comparable at least with that expected for the degree of doctor of philosophy. Application blanks may be obtained from the School of Mathematics, Institute for Advanced Study, Princeton, N.J. Completed forms must be returned *by 1 Jan. 1957.*

■ The National Science Foundation will make available a limited number of individual travel grants to partially defray the travel costs of American scientists who wish to attend the following international congresses:

Second International Congress of Photobiology, Turin, Italy, 1–9 June 1957; application deadline, *1 Jan. 1957.*

Fourth Congress of the International Association of Gerontology, Merano, Italy, 14–19 July 1957; application deadline, *1 Jan. 1957.*

First International Congress of Neurological Sciences, Brussels, Belgium, 21–28 July 1957; application deadline, *1 Jan. 1957.*

Fifteenth International Congress of Psychology, Brussels, Belgium, 28 July–3 Aug. 1957; application deadline, *1 Feb. 1957.*

Fourth International Congress on Nutrition, Paris, France, 24–29 July 1957; application deadline, *1 Jan. 1957.*

Congress of the International Union for the Scientific Study of Population, Stockholm, Sweden, 8–15 Aug. 1957; application deadline, *1 Mar. 1957.*

Sixth Congress of the International Society for the Study of Biological Rhythms, Semmering, Austria, 26–28 Aug. 1957; application deadline, *1 Jan. 1957.*

Ninth International Congress of Cell Biology, St. Andrews, Scotland, 28 Aug.–2 Sept. 1957; application deadline, *1 Jan. 1957.*

Ninth General Assembly of the International Union of Pure and Applied Physics, Rome, Italy, Sept. 1957, and associated meetings; application deadline, *10 Jan. 1957.*

Application blanks may be obtained from the National Science Foundation, Washington 25, D.C. The screening of applications will generally be made by an appropriate ad hoc advisory committee. For example, in the case of the Cell Biology Congress, arrangements have been made with the American Institute of Biological Sciences to establish a committee of representatives from scientific societies concerned with cell biology to evaluate applications and to decide the basis for recommending grantees to the foundation.

■ The U.S. Atomic Energy Commission special fellowships in industrial medicine for 1957–58 have been announced by the Atomic Energy Project, School of Medicine and Dentistry, University of

Rochester, which administers the program. The fellowships are open to men and women physicians who are citizens of the United States, who have graduated from an approved college of medicine at least 2 years prior to beginning tenure of the fellowship, and who are licensed to practice medicine in one of the states or territories of the United States. Successful candidates will be required to have a full FBI background investigation and to be cleared by the commission prior to award of a fellowship. The training program consists of two parts:

1) An academic year, with lecture and laboratory instruction in the practice of industrial medicine, industrial hygiene, industrial toxicology, nuclear physics, biophysics, biostatistics, and the public health aspects of occupational medicine. When recommended by the training school, an extension of the fellowship for a second academic year may be granted.

2) An in-plant training year, in which the fellow will be assigned to one or more of the medical departments in a major plant or laboratory operating under the direction of the AEC. Here he will have an opportunity to apply much of the material acquired during the academic phase and to participate in, under special supervision, the operation of an active industrial medical service.

The stipend during a fellowship or academic year is $3600. The sum of $350 is added to the total stipend for a wife, and $350 more is added for each dependent child. Tuition and laboratory fees, which would be required of students of similar university status, will be paid in academic courses. Certain other expenses incident to the work of the fellow will be paid when approved by the committee. During the in-plant year the stipend will be $6000.

Applications must be received *before 1 Jan.* by Dr. Henry A. Blair, A.E.C. Fellowships in Industrial Medicine, Atomic Energy Project, University of Rochester, School of Medicine and Dentistry, Rochester 20, N.Y.

■ The American Cancer Society has announced that it is now prepared to receive applications for research grants under its newly reorganized research program. Until this year the society has been advised by the National Research Council's Committee on Growth on several types of grants. This year the society will be guided by its own committees and a staff under the direction of Harry M. Weaver, the society's administrator for research.

The society can distribute at least $7 million in 1957 to individual scientists and research institutions prepared to investigate problems pertinent to cancer control. Types of grants include project grants, program grants, institutional research grants, contracts for research, postdoctoral fellowships, scholars in cancer research and additional faculty-level positions.

Application forms may be obtained by writing to the American Cancer Society, 521 W. 57 St., New York 19, N.Y. Applications received *before 1 Jan.* will be acted upon during the late winter and early spring, and most grants will become effective 1 July 1957. Other deadlines for receipt of applications will be 1 May and 1 Sept.

■ Grants totaling $15,140,154 for the fiscal year 1955–56 were reported by the Commonwealth Fund in its recent annual report. Of this total, $12,600,000 represented unrestricted grants to 19 universities in order to assist them in strengthening their programs of medical education. In this year's report, the Commonwealth Fund reviews at length the direction and rapidity of growth in medical education during the past 10 years and relates this year's unrestricted gifts to other support for medical education that it has extended during the current and earlier years. The review points out some of the approaches by university medical schools toward a more inclusive type of educational program, beginning with the postwar interest in mental health as a day-to-day concern in medicine and in the integration of psychiatry into clinical fields such as internal medicine and pediatrics.

Two other forms of giving designed to fill important existing needs are also described in this year's annual report. The first is for fluid research funds to provide outstanding investigators freedom to explore and develop potentially promising leads growing out of their current research. The second is for special awards to mature scientists and scholars in support of creative work in the health field.

During the course of the year 1955–56, project or program support was given to nine institutions for various activities in medical education. Patient care and the relationship of the university to its community were the central themes of three; teacher training and teaching techniques, of five; and research in medical education, of one.

Closely allied with grants made for medical education were 23 fellowship awards to individuals for advanced study and experience in the health field, three block grants for the education of nurses at the master and doctorate levels, and one grant under the category of experimental health services.

As in previous years, the Commonwealth Fund's interest in medical research continued to focus on investigation that will contribute new knowledge and increased understanding of man as a "total organism." During the year, 25 different programs of research were being conducted, with fund assistance, in 17 university medical schools, teaching hospitals, or research laboratories. Six of these represented grants made for the first time in 1955–56.

In the Laboratories

■ The U.S. Atomic Energy Commission has announced that it has been informed of the formation of Carolina-Virginia Nuclear Power Associates, Inc., a nonprofit corporation for the development of atomic power. The certificate of incorporation was filed in North Carolina by the Virginia Electric and Power Company, the Carolina Power and Light Company, the Duke Power Company, and the South Carolina Electric and Gas Company. The announcement raises to six the number of atomic power projects initiated by private industry without any direct financial participation by the Government.

■ The General Electric Company is building the Dresden Nuclear Power Station for the Commonwealth Edison Company and the Nuclear Power Group, Inc. The nuclear reactor will be housed in a steel sphere 190 feet in diameter. Construction work on the $45-million plant will start next spring, with completion set for mid-1960. The 180,000-kilowatt station is the largest all-nuclear power plant yet scheduled in this country and is being financed entirely with private funds.

It will be located 50 miles southwest of Chicago and will become part of the Commonwealth system, which will own and operate the plant. Associated with Commonwealth in the Nuclear Power Group are the American Gas and Electric Service Corporation, the Bechtel Corporation, the Central Illinois Light Company, the Illinois Power Company, the Kansas City Power and Light Company, the Pacific Gas and Electric Company, and the Union Electric Company.

■ The U.S. Atomic Energy Commission has begun contract negotiations with the Aerojet-General Corporation of Azusa, Calif., for the design, fabrication, and operation of a gas-cooled reactor experiment at the National Reactor Testing Station in Idaho. The experiment is intended to develop engineering data and experience for the design and construction of military package power reactors and small civilian central station power plants.

The gas-cooled concept is the eighth type chosen by the AEC for research and development work in the program to achieve economic power reactor systems. Twenty firms responded to the commission's invitation last June to submit proposals [*Science* **124**, 72 (13 July 1956)].

Reports

Boltwoodite, a New Uranium Silicate

The mineralogic studies accompanying the development of the uranium ores of the Colorado Plateau have already resulted in the discovery of numerous uranium and vanadium minerals new to science. The present mineral, boltwoodite, was found during a study of the mineralogy of the Delta Mine, familiarly known as Pick's Mine, on the western edge of the San Rafael Swell, Emery County, Utah.

Chemical analysis and a spectrographic study prove the substance to be a potassium uranyl silicate near $K_2(UO_2)_2(SiO_3)_2(OH)_2 \cdot 5H_2O$ in ratios. It is the only uranyl silicate known that contains an alkali as an essential cation. X-ray powder diffraction study suggests a structural relation to sklodowskite, $Mg(UO_2)_2(SiO_3)_2(OH)_2 \cdot 5H_2O$. Single-crystal x-ray and morphological study was precluded by the small size of the crystals.

Boltwoodite occurs as yellow wartlike aggregates of fibers coating fractures in sandstone. It is an oxidation product of primary black ores that contain quadrivalent uranium. Associated minerals are brochantite, becquerelite, gypsum, and coarse golden fibers of an unidentified uranyl silicate. It is optically biaxial negative, with parallel extinction and weak pleochroism; *n* X, 1.668 (colorless); *n* Y, 1.696? (yellow); *n* Z, 1.703 (yellow). The mineral may be orthorhombic or, like sklodowskite, monoclinic with the fiber elongation along the *b*-axis. The specific gravity is about 3.6. The mineral is weakly fluorescent in dull green under both long- and shortwave ultraviolet excitation. The first ten lines of the x-ray powder pattern, including the four darkest lines, are as follows: *d*, 6.81 A, I 10; 6.42, 4; 4.72, 4; 4.29, 3; 4.08, 1; 3.53, 7; 3.39, 8; 3.12, 5; 2.94, 8; 2.89, 6.

Analysis of a small sample containing brochantite and small amounts of unidentified materials gave the following results: K_2O, 8.03; Na_2O, 0.33; UO_3, 58.68; SiO_2, 12.74; CuO, 9.61; SO_3, 2.12; H_2O, 7.33; insoluble, 0.19; not determined, 0.34 (AL_2O_3, CaO, MgO, PbO, V_2O_5); total, 99.88 percent. Recalculation to 100 after deducting brochantite, $Cu_4(SO_4)(OH)_6$, with insoluble and undetermined portions, gave the following results (percentages calculated from the cited formula are in parentheses): K_2O, 9.4 (10.75); Na_2O, 0.4; UO_3, 68.5 (65.28); SiO_2, 14.8 (13.70); H_2O, 6.9 (10.27); total 100.00 percent.

The mineral is named after Bertram B. Boltwood (1870–1927), radiochemist of Yale University, who provided evidence that lead was the final disintegration product of uranium and devised the very fruitful method of measuring geologic time on the basis of the lead content of uranium minerals.

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24 September 1956

Effect of Hypothermia on Epileptiform Activity in the Primate Temporal Lobe

According to Noell and Briller (*1*), the hypothermic brain is in a "latent preconvulsive state." In their experiments, they stimulated the lateral geniculate with an intense repetitive current. Hypothermia seemed to facilitate the production of paroxysmal afterdischarges, which followed the electric stimulus. Likewise, they concluded that the analeptic action of Metrazol, caffeine, and strychnine is enhanced at low temperatures. These observations have been confirmed by others (*2*).

This work leads one to expect that the production of afterdischarges by intense repetitive stimulation can be facilitated in hypothermic conditions. With this expectation, we began the application of hypothermia to certain experimental preparations (*3*).

Our experimental animals were two 3-year-old male chimpanzees weighing 10 and 8.2 kg, respectively. We had introduced bipolar stainless-steel electrodes into the temporal lobes of each animal. These electrodes were directed so that the uninsulated tips lay just mesial and superior to the anterior end of the temporal horn. We directed the electrodes toward the lateral horn after we had outlined it by air. After the introduction of the electrodes, we x-rayed the head of each animal in lateral and anteroposterior projections to establish the general location of the electrode tips. The electrodes were fastened to the skull by an acrylic substance and then connected to wires that passed beneath the galea to a stab wound in the midline of the neck. Then we placed subdural recording electrodes over the frontal, temporal, and parietal cortices. These were connected to subgaleal leads that emerged from the stab wound in the lower cervical region.

The operative procedures were accomplished with sterile technique under light Pentothal anesthesia. Both animals made a good recovery.

Two weeks later we began intense repetitive stimulation of the depth electrodes. The animals were stimulated while they were under light Pentothal anesthesia and in a conscious, freely moving condition. Stimulation was derived from a Grass S-4B stimulator, and its electric effects were recorded by an eight-channel Grass electroencephalograph. The details of this technique and the results of its application have been described elsewhere (*4*). The average stimulus required for the development of convulsive phenomena at normal temperatures was a series of 8-v, 60-cy/sec, 2.5-msec pulses lasting 5 seconds. After the convulsive threshhold had been determined at normal temperatures, each animal was given Pentothal and intubated. The anesthesia was accompanied by the administration of 20 mg of succinyl chloride. The anesthesia was in all respects similar to that applied at normal body temperature. Then the body temperature was reduced by means of ice packs and a Davol water mattress, and after 45 minutes the rectal temperature reached 25° to 26°C. Next, we applied repetitive electric stimulation to the depth electrodes and recorded the effects.

No epileptiform activity was observed in either hypothermic animal after repetitive stimulations within previously established parameters. In each hypothermic preparation, we applied repetitive stimuli ranging from 5 to 100 v at 60 cy/sec and 2.5-msec duration. Indeed, no epileptiform activity whatsoever was recorded in the first hypothermic animal. In the second hypothermic preparation, we did record an electrographic seizure after repetitive stimulation at 100 v. This seizure discharge was apparently localized to the ipsilateral temporal cortex. In addition, there was some electrographic abnormality in the tracing from the scalp electrode at the vertex. However, there was no evidence of epileptiform activity in the frontal, parietal, or opposite temporal cortex, nor were there any facial movements.

The hypothermia was continued for 90 minutes. Thereafter the animals were

warmed until the rectal temperature reached 36°C. This procedure required 30 minutes. During the warming, the second animal developed a spontaneous electrographic seizure localized to the right temporal cortex.

Both animals recovered without incident, and 24 hours later the repetitive stimulation was repeated. This was accomplished without anesthesia, while the animals were conscious and alert. In this condition, epileptiform activity was evoked with ease by stimulation with 20-v 60-cy/sec, 2.5-msec pulses. The clinical and electrographic effects of this stimulation were similar to those recorded before the application of hypothermia.

Finally, each animal was anesthetized, intubated, and immobilized by intravenous administration of succinyl chloride. Respiration was maintained by manual compression of the anesthesia bag. The Pentothal anesthetic was discontinued so that the animal was receiving oxygen by endotracheal tube and succinyl chloride by vein during artificial respiration.

Thirty minutes after the Pentothal had been discontinued, we began repetitive stimulation of the depth electrodes. Electrographic and clinical seizures occurred after stimulation with 12-v, 60-cy/sec, 2.5-msec pulses. The clinical seizures were confined to the face, and the electrographic tracings were quite similar to those obtained when the animal was in the unanesthetized state.

Figure 1 summarizes the electrographic recordings made at normal temperatures and under hypothermic conditions.

Actually, it was easy to establish afterdischarge by repetitive stimulation of the mesial temporal region at normal temperatures. Under the conditions of hypothermia, it was very difficult to do this.

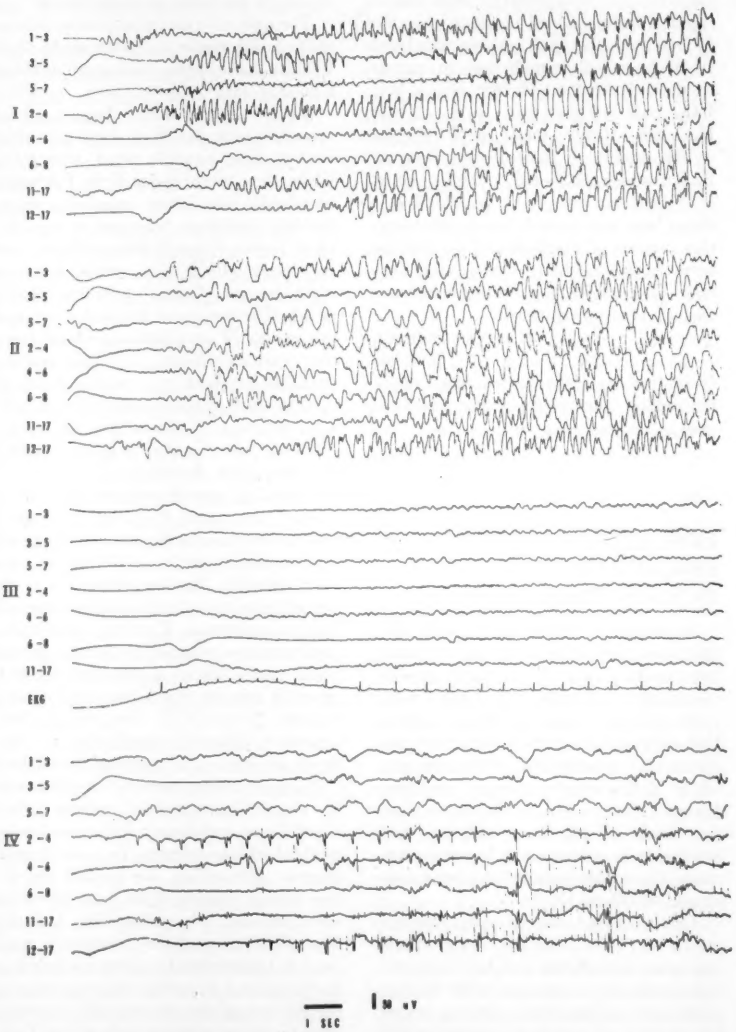

Fig. 1. Effect of hypothermia on epileptiform activity. Nos. 1 to 6, subdural electrodes on temporal cortex; Nos. 7 and 8, subdural electrodes on frontal cortex; Nos. 9 and 10, subdural electrodes over parietal cortex; Nos. 11, 12, and 17, needle electrodes inserted subcutaneously (i) over the midtemporal area (Nos. 11 and 12) and (ii) at the vertex at the midline (No. 17). Odd numbers indicate left side; even numbers, right side. Tracing I, generalized electrographic seizure in the freely moving animal following a stimulation at 10 v. Tracing II, generalized electrographic seizure in the anesthetized animal following a stimulation at 15 v. Normal temperature. Tracing III, no electrographic seizure in the anesthetized animal following stimulation at 70 v; temperature 30°C. Channel 8 is EKG. Tracing IV, localized seizure in the anesthetized animal following stimulation at 100 v; temperature 29.5°C.

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26 September 1956

Suspected Correlation between Blood-Group Frequency and Pituitary Adenomas

The number of cases proving that the blood group genes are not selectively neutral is increasing rapidly. Since various summaries have been published recently, only our own findings will be reported here (*1*). Blood groups of patients in Boston hospitals with duodenal ulcer and carcinoma of the stomach were analyzed in a preliminary study, in order to determine whether the racially more heterogeneous American population would give deviations comparable to those found by various groups of British workers, beginning with Aird's (*2*) pioneering study.

The frequency of blood group A was found to be as much as 42.08 percent in patients with carcinoma of the stomach ($N = 663$), as compared with a frequency in the Massachusetts population

($N = 120,281$) of 39.7 percent, the latter based on the work of MacCready and Manin (*3*). In the sample of patients with duodenal ulcer ($N = 144$) the frequency of group O was found to be 61.11 percent, as compared with 45.8 percent in the Massachusetts population. Similar findings for an Iowa population have been published by Buckwalter *et al.* (*4*). Although the magnitude of the deviation from the control is not identical in these various investigations, the direction is the same in all cases. This indicates that deviation from neutrality can be demonstrated even in the racially heterogeneous North American population.

An opportunity arose to extend this research to patients with brain tumors and pituitary adenomas, owing to the encouragement and exceptionally effective assistance of several neurosurgeons (*5*).

An analysis of 637 cases of brain tumors (Table 1) shows that the ABO gene frequencies do not deviate to any marked extent from those of the Boston population. There is an indication in glioblastoma multiforme and in meningeoma of a slight excess of group B, but the samples and deviations are too small to yield data of statistical significance. The diagnosis was confirmed by a tissue analysis in all cases, except some of those recorded as "unclassified."

The distribution of the ABO blood group in chromophobe adenoma of the pituitary is interesting. After a consistent striking deviation from population average was found in three Boston hospitals, two New York hospitals were included in the survey. A considerable excess of group O was found in each of the five hospitals (Table 2). Likewise, there was a striking deficiency of group A in each of these samples, while levels of group B were normal in some and perhaps slightly excessive in others.

There are relatively few hospitals where brain tumors and pituitary adenomas are operated, and these few may draw their patients from considerable distances. Although the great majority of the tabulated cases were from the Boston or New York areas, several patients were from as far away as South America. The sample of the Massachusetts population has, therefore, only limited usefulness as control. The sample of brain tumors (Table 1) was therefore chosen as control sample for the statistical analysis of the blood group frequencies in pituitary adenoma (Table 2). There is no indication that the population from which the pituitary-adenoma sample was drawn is different in any way from the population from which the brain-tumor sample was drawn. Chi square comparisons of pituitary adenoma (Table 2) with brain tumors (Table 1) yielded the following results. Group O compared with the sum of the other blood groups (A + B + AB): $\chi^2 = 9.97$, $p = 0.0017$. Group A compared with the sum of the other blood groups (O + B + AB): $\chi^2 = 18.45$, $p = < 0.0001$. There is no significant deviation for B or AB. In view of the smallness of the total sample, it is advisable to consider these findings as tentative, in spite of the statistical significance of the deviation and the concordance of the data from four of the five hospitals (Table 2).

Table 1. Distribution and frequency of ABO blood group in brain tumors in Boston hospitals.

Item	Group								Total *N*
	O		A		B		AB		
	N	%	*N*	%	*N*	%	*N*	%	
Glioblastoma multiforme	78	46.62	72	39.34	26	14.21	7	3.83	183
Astrocytoma	73	45.91	64	40.25	19	11.95	3	1.89	159
Ependymoma	9	50.00	8	44.49	1	5.56	0	0	18
Meningeoma	71	43.29	63	38.41	24	14.63	6	3.66	164
Acoustic Neuroma	26	44.07	24	40.68	7	11.86	2	3.39	59
Rare types*	12	48.00	10	40.00	2	8.00	1	4.00	25
Unclassified	13	44.83	11	37.93	2	6.90	3	10.34	29
Total brain tumors	282	44.27	252	39.56	81	12.72	22	3.45	637
Boston population	55,089	45.80	47,752	39.70	12,990	10.80	4450	3.70	120,281

* Medulloblastoma, Pinealoma, Oligodendroglioma.

Table 2. Distribution and frequency of ABO blood group in chromophobe adenoma of the pituitary and controls.

Item	Group								Total *N*	% increase in group O*
	O		A		B		AB			
	N	%	*N*	%	*N*	%	*N*	%		
Massachusetts General Hospital	11	61.11	3	16.67	4	22.22	0	0	18	33.43
N.E. Deaconess Hospital	22	62.86	8	22.86	4	11.43	1	2.86	35	37.23
Baptist Hospital	2	50.00	1	25.00	1	25.00	0	0	4	9.17
Total Boston hospitals	35	61.40	12	21.05	9	15.79	1	1.75	57	34.06
New York Hospital, N.Y.	12	52.17	3	13.04	7	30.43	1	4.35	23	13.91
Presbyterian Hospital, N.Y.	27	62.79	9	20.93	3	6.98	4	9.30	43	37.10
Total, pituitary adenoma	74	60.16	24	19.51	19	15.45	6	4.88	123	31.35
Total, brain tumors	282	44.27	252	39.56	81	12.72	22	3.45	637	
Boston population	55,089	45.80	47,752	39.70	12,990	10.80	4450	3.70	120,281	

* Over total, brain tumors.

These findings raise some interesting questions. In most other previously established cases of a correlation between a pathological condition and blood groups, the intestinal tract (stomach, duodenum, pancreas) was involved directly or indirectly. With the pituitary, an endocrine gland is found to be concerned. What particular attributes of group O should make carriers of group O more and of group A less readily subject to abnormal growth of the chromophobe cells of the pituitary is a complete mystery. Yet the new findings are in line with the broad concepts of population genetics that genes have pleiotropic effects and may participate in a great many aspects of the phenotype. Since pituitary adenoma is a very rare condition, mortality due to this condition will not contribute much to depress the frequency of group O in the population. Particularly unbalanced blood group frequencies are perhaps more likely to occur in rare than in common diseases, although they are not absent in common ones (for example, duodenal ulcer and carcinoma of the stomach).

The present findings accentuate the problem of the rarity of group B in the European and North American population. It is the rarest gene of the ABO blood group, yet so far it has not been found to be discriminated against in a single pathological condition. What factor depresses group B to its low frequency is, as Aird (*6*) has pointed out to us, one of the great puzzles of the blood group field. Some childhood or infectious disease is most suspect.

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16 August 1956

Isolation and Properties of Corticotropin from Bovine Pituitary Glands

The structural formulas that have been elucidated for ACTH preparations isolated from ovine (*1*) and porcine (*2, 3*) pituitary glands (α-corticotropin and corticotropin-A, respectively) have revealed that these preparations are not identical. A recent note by White and Peters (*4*) describes the results of preliminary physical and chemical studies on a bovine ACTH preparation; similarities in amino acid composition between the bovine preparation and porcine corticotropin-A, as well as an identity in the patterns of amino acids that were released when these two preparations were treated with enzymes, were noted. We would like to report (*5*) that in this laboratory an identical amino acid composition has been found for bovine ACTH as for the ovine (*6, 7*) product (α-corticotropin), and in addition, that the hormones of these latter two species manifested identical behavior in resin column chromatography and in countercurrent distribution. Hence, the properties of bovine ACTH would seem to be closer to those of the ovine than to those of the porcine hormone.

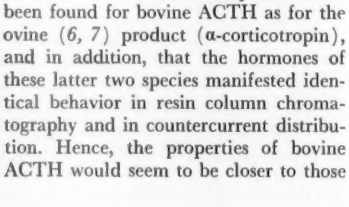

Fig. 1. Chromatography on the Na form of Amberlite XE-97 resin (dimensions of column, 0.9 by 24 cm) of an ACTH concentrate (20 mg) obtained from beef pituitary glands; 3 ml per tube. The hormonal activity is located in peaks II_1 and II_2.

The bovine corticotropin was isolated from whole beef pituitaries by the same procedure previously described for the hormone from sheep glands (*6, 7*), except for omission of the step involving zone electrophoresis on starch. The chromatographic pattern of the concentrate obtained at the dioxane step on the Amberlite IRC-50 (XE-97) column may be seen in Fig. 1; the activity was found in peaks II_2 and II_1. It may be noted that the positions of these two active peaks are identical with those obtained (*7*) with the ovine ACTH concentrate. The material in peak II_2 was desalted and submitted to 200 transfers in an all-glass countercurrent distribution apparatus (*8*) in a 2-butanol/0.2-percent trichloroacetic acid system (Fig. 2). The material in those tubes falling within the theoretical distribution curve for a partition coefficient (K) of 1.06 was found to be active (*9*), and it behaved as a single substance when it was submitted to terminal amino acid analyses. It may be recalled that corticotropin-A (of porcine origin) distributes in the 2-butanol/0.2-percent trichloroacetic acid system with a K value of 1.82 (*10*), whereas α-corticotropin in the same solvent system distributes with a K value of 1.0 (*11*).

The molar ratios of amino acids in the bovine hormone are as follows: alanine, 3; arginine, 3; aspartic acid, 2; glutamic acid, 5; glycine, 3; histidine, 1; leucine, 1; lysine, 4; methionine, 1; phenylalanine, 3; proline, 4; serine, 3; tryptophan, 1; tyrosine, 2; and valine, 3. Tyrosine and tryptophan were estimated spectrophotometrically (*12*), while the other amino acids, including tyrosine, were estimated by quantitative paper chromatography of their dinitrophenyl derivatives (*13*). It can be noted that these values are identical with those found for α-corticotropin (*14*). Earlier investigations (*2, 6, 14*) showed that there is a difference in amino acid composition between the peptide hormones isolated from sheep and from pig glands —namely, one more serine and one less leucine in the former.

N-terminal amino acid anaylsis of the bovine hormone by means of both the fluorodinitrobenzene and phenyl*iso*thiocyanate procedures (*15*) disclosed serine as the sole terminal residue. The paper-strip modification (*16*) of the phenyl*iso*thiocyanate method yielded the following N-terminal sequence for bovine corticotropin: serine, tyrosine, serine, methionine. . . . The amino acid released from the carboxyl end of the peptide hormone obtained by the carboxypeptidase procedure (*17*) was phenylalanine. Thus, with respect to N-terminal amino acid sequence and the C-terminal residue, the hormones of all three species are identical (*1–3, 18*).

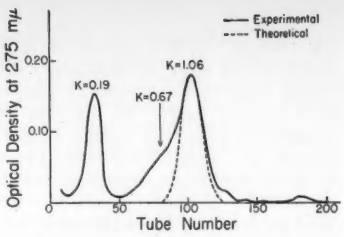

Fig. 2. Countercurrent distribution (200 transfers) of material (77 mg) obtained from chromatography on an XE-97 resin column (see Fig. 1); system, 2-butanol/0.2-percent aqueous trichloroacetic acid. The component with $K = 0.6$ is the bovine corticotropin.

The findings reported here indicate an identity between bovine ACTH and α-corticotropin, but the final proof for this conclusion must await the elucidation of the structural formula of the bovine hormone. Such structural studies are now being carried out and will be reported in a subsequent paper.

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9. From 1 kg of whole beef pituitaries, the yield of the hormone averaged about 8 mg. When the material was assayed in hypophysectomized rats, it possessed an ACTH potency similar to that of α-corticotropin. Like the sheep hormone, the corticotropin from beef pituitaries has a melanocyte-stimulating activity.
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Amino Acids Formed in "Primitive Atmospheres"

Simulating atmospheric conditions that might have been present early in the history of the earth, amino acids such as alanine, β-alanine, glycine, and sarcosine have been synthesized employing a variety of compositions. Combinations of gases, including CO_2—N_2—H_2—H_2O, CO—N_2—H_2—H_2O, CO_2—NH_3—H_2—H_2O, were subjected to electric discharges, and in each case amino acids were formed. The earlier work of S. Miller [*J. Am. Chem. Soc.* **77**, 2351 (1955)] employing CH_4—NH_3—H_2O has been confirmed.

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Progress in Solving the Problem of Acute Respiratory Disease

From time immemorial, the human race has been plagued with a great mass of acute respiratory illnesses. Scientific progress toward alleviation of these illnesses began with recognition and classification of the various respiratory diseases according to their clinical signs and symptoms, their pathology, and the nature of their epidemiological occurrence. At this stage of progress, epidemiological observations occasionally indicated methods of control which were generally limited to environmental changes such as isolation and quarantine.

Gradually over the years, specific fungi, bacteria, and viruses were found to be the cause of some of the respiratory illnesses. Whenever such an etiologic agent was discovered, laboratory methods of diagnosis permitted a more precise definition of the clinical, pathological, and epidemiological characteristics of the illness and enabled its reclassification as an etiologic disease entity. As methods are discovered which permit ready laboratory cultivation of such agents, the door is opened for development of specific measures for preventing or treating the disease.

This discussion summarizes the progress of science in studies of acute respiratory illness with particular emphasis on recent developments. It briefs the discovery of a new group of respiratory-tract viruses, the nature of disease produced by these viruses, and the development of vaccines for preventing these diseases.

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High-Pressure Silicates

Recent advances in high-pressure instrumentation at this laboratory and other laboratories have made it possible for geologists to extend their phase equilibrium studies to a pressure of 70,000 atm at high temperature. Hitherto, our information about the nature of materials existing in the earth at great depths has come primarily from seismology. We now, however, have techniques with which to investigate in the laboratory the stability of common minerals up to a pressure corresponding to a depth of more than 100 miles.

Experiments have shown that silicates with open, network structures, such as quartz, the feldspars, and the feldspathoids, are unstable at conditions of temperature and pressure believed to be present below the earth's crust. Under such conditions these minerals, which form the major part of the rocks of the earth's crust, invert or break down to high-pressure phases. New high-pressure phases have been discovered in these investigations.

Transitions to high-pressure phases may be sharp, as is the case with the simple transition quartz $\leftrightarrows$ coesite. In chemically more complex systems, transitions can take place over a range in temperature and pressure; this is the case with the breakdown of the feldspathoid nepheline. Seismic discontinuities at the base of the earth's crust and in the upper part of the earth's mantle may possibly be explained as due to similar phase transitions.

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Effect of the Osmotic Strength of the Growth Medium on the Amino Acid Pool of Escherichia coli

When *Escherichia coli* cells are supplied with an amino acid, it is first taken up into a "pool" and then incorporated into the protein macromolecules. The mechanisms of pool formation and maintenance are being studied in order to understand their relationship to the process of protein synthesis.

Escherichia coli cells grown in a standard salts-glucose medium, supplemented with proline, form a pool proportional to the external amino acid concentration. The internal or pool concentration is 500 times the external proline concentration until the latter reaches 5 μg/ml. Above this concentration the pool maintains a constant saturation level. This saturation level is roughly proportional to the osmotic strength of the medium.

When cells that have formed a proline pool in the standard medium are rapidly washed with the standard medium or with solutions of glucose, sucrose, glycine, or NaCl of the same osmotic strength, the pool is unaffected. Washing with solutions of lower osmotic strength removes part of the pool proline, and a water wash completely removes the pool proline. Recovery from such an osmotic shock is very rapid. Rapidly water-washed cells reform a pool within 1 to 2 minutes when they are resuspended in standard medium supplemented with proline.

These osmotic effects cannot be interpreted in terms of any of the simple models that have yet been considered, and it appears that an investigation of the internal structures of the cell will be necessary for their interpretation.

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Survival of Enucleate Cytoplasm of Human Cells in Tissue Culture

Instrumentation necessary to permit micromanipulation and cinemicrography of human cells in tissue culture has been developed and is described. Essentially, the system is characterized by internal temperature regulation and recording in a chamber mounted on the stage of an inverted microscope and sealed with an oil "coverslip" through which a microtool can be passed for micromanipulation. The problems characteristic for cultivation of human cells in this system have been met successfully. These include control of injury by light, reduced dependence on bicarbonate buffers in the nutrient medium, and provisions for control of temperature without interference with micromanipulative techniques. The latter have been refined to deal with the size and character of human cells in culture.

Human carcinoma cells, strain HeLa, have been observed for several days in this system without apparent deviation from the state of parallel cultures maintained under more standard conditions. Division of cells has been performed for isolation of enucleate cytoplasm. Continuing dynamic activity of enucleate cytoplasm has been observed for periods up to 40 hours at varying temperature levels. Vital manifestations in the independent cytoplasm indicate that selected cells are capable of sealing after micrurgy, that cell boundaries remain actively amoeboid, that enucleate cytoplasm can migrate, and that cytoplasmic organelles retain normal morphologic and dynamic features. These signs of "survival" terminate abruptly when the enucleate cytoplasm undergoes shrinkage and becomes immobile. The time-temperature relationships of "survival" of enucleate cytoplasm suggest that resources for some normal activities of cytoplasm are in-

trinsic to the cytoplasm and independent of the nucleus for appreciable periods. The state of the culture at the time of micrurgy is evidently important and is discussed. Time-lapse motion picture records are available.

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Reaction of Cell Fractions of the Thymus Gland to Enzymatic Digestion and Changes in Osmotic Pressure

Tissue homogenates of the calf thymus gland prepared in 0.25*M* sucrose plus 0.0018*M* $CaCl_2$ have been shown to contain a certain contamination of intact thymocytes, the extent of which seems to vary from preparation to preparation. Separation of these thymocytes (which appear almost identical to isolated nuclei) from the nuclear fraction of the homogenate by means of differential centrifugation has so far been entirely unsatisfactory. A source of error of unknown magnitude therefore exists in determinations of nuclear enzymatic activity from such preparations.

During a search for a quick and accurate method to determine the degree of such contamination, preparations of thymus homogenate were subjected to enzymatic digestion by trypsin, chymotrypsin, and desoxyribonuclease. Photomicrographs of samples taken during digestion show partial digestion of the nuclei, but some of the formed objects are resistant to such digestion and are presumed to be intact thymocytes.

These resistant thymocytes were subsequently treated with hypotonic (0.001*M*) $CaCl_2$ and showed the previously described swelling and rupture with extrusion of the nucleus. Work on adapting this test to quantitative determinations is continuing.

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Discriminatory Temperature Indication in the Electron Transport System

In investigations of the effect of temperature on the phosphorylative activities of mitochondria prepared from rat liver, it is found that temperature changes from 25° to 45° cause slight decreases in phosphorylation efficiency and an increase in the "respiratory control"—the ratio of the respiratory rates in the active state (with added phosphate acceptor) and the quiescent state (without added phosphate acceptor)—to a maximum at 39°C and a decrease above this value. The steady-state oxidation-reduction levels of the respiratory enzymes have been studied by sensitive spectrophotometric methods and are found to change in a characteristic manner upon the transition from the quiescent to the active state. The nature of these changes is now found to be temperature sensitive in a particularly interesting fashion.

In the case of the flavoprotein component of the respiratory chain, oxidized flavoprotein is formed in this transition at 25°C. The amount oxidized falls as the temperature increases from 25°C, becomes zero in the region of 37°C, and at temperatures above this region reduced flavoprotein is formed in the transition (up to 45°C). Thus in the respiratory chain we find DPNH to be oxidized, flavoprotein to be reduced, and cytochrome *b* to be oxidized in the quiescent-active transition at the higher temperatures. On the basis of our current views of the mechanism of oxidative phosphorylation, flavoprotein would be eliminated as a possible site of phosphorylation, and the remaining three sites identified by these methods are DPNH, cytochrome *b*, and cytochrome *c*.

This extraordinary behavior of flavoprotein in this transition as a function of temperature simulates a discriminatory temperature indicator; it gives not only the magnitude but also the sign of the temperature deviation from 37°.

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Eldridge Reeves Johnson Foundation

Crystal Structure of Meyerhofferite

Meyerhofferite ($2CaO.3B_2O_3.7H_2O$) is triclinic $P\bar{1}$, $a = 6.63$, $b = 8.35$, $c = 6.46$ A (all ± 0.015 A), $\alpha = 90°46'$, $\beta = 101°59'$, $\gamma = 86°55'$ (all ± 05′); $Z = 1$ [$2CaO.3B_2O_3.7H_2O$], density (calc.) = 2.125, density (obs.) = 2.120. The structure was determined from electron-density projections normal to the three crystallographic axes, calculated using phases determined by the direct statistical method of Hauptman and Karle.

The crystal contains polyions consisting of two $BO_3(OH)_2$ tetrahedra and a $BO_3(OH)$ triangle, linked to form a ring of composition $[B_3O_5(OH)_5]^{-2}$. The average B - O distance in the tetrahedra is 1.49 A and in the triangle, 1.38 A. Each Ca^{++} is coordinated by six oxygens and one H_2O at an average distance of 2.40 A. The structural formula for meyerhofferite is $CaB_3O_5(OH)_5.H_2O$. The isolated groups in meyerhofferite are the same elements that condense to form the infinite chains of colemanite:

$$n[B_3O_3(OH)_5]^{-2} = [B_3O_4(OH)_3]_n^{-2n} + nH_2O$$

Reliability factors for the initial structure are: h01, 0.19; hk0, 0.19; 0k1, 0.21. At the present stage of refinement the atomic parameters are as follows.

Atom	*x*	*y*	*z*
Ca	0.010	0.377	0.243
O_1	0.407	0.734	0.327
O_2	0.422	0.889	0.651
O_3	0.115	0.776	0.502
O_4	0.339	0.461	0.211
O_5	0.058	0.642	0.145
O_6	0.165	0.374	0.615
O_7 (H_2O)	0.132	0.104	0.211
O_8	0.145	0.126	0.797
O_9	0.334	0.673	0.955
B_1	0.318	0.792	0.497
B_2	0.308	0.642	0.183
B_3	0.030	0.278	0.683

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U.S. Geological Survey

Some Experiments with Fractionation by Partial Dialysis

Dialysis through cellophane has long been used as a convenient method for separating dialyzable solutes from nondialyzable ones. Recent studies on the rates of passage of various solutes through this material have now shown that simple dialysis can have a much wider application in biochemistry than has been heretofore realized.

For a given membrane, the rate of escape of an ideal solute in solution on one side of the membrane to a solution of essentially zero concentration on the other is analogous to first-order reaction kinetics. A plot of the logarithm of the decrease in concentration against time should give, and with a pure solute has been found to give, a straight line. With an unknown preparation the degree of adherence to a straight line can be of value in studying homogeneity with respect to size and shape (and perhaps charge).

Comparison of the rates of escape of different-sized solutes in different membranes has shown that a much higher selectivity in separating them can be achieved than if the process was based on simple diffusion alone. This leads to a useful separation tool based mainly on molecular size. An easy way of deriving approximate molecular sizes with unknowns by comparison of rates with those of similar known solutes is also indicated.

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Evidence of Evolutionary Forces Leading to the Spread of Lethal Genes in Wild Populations of Mice

Mutant alleles at one locus, most of them lethal to embryos, are widespread in populations of wild house mice (*Mus musculus*) in the United States. The distribution and inheritance of 16 such alleles is described. In all cases males carrying such alleles transmit them to 90 to 99 percent of their offspring. It is mainly this altered transmission ratio which accounts for the high frequency of such alleles, even when their spread is opposed by complete selection against homozygotes. In addition, animals heterozygous for either of the two alleles of which special studies have been made are favored by natural selection. The effects of the transmission ratio and selection on equilibrium in wild populations are discussed.

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Studies on Polysaccharide Formation by a Rumen Bacterium

The rumen bacterial population is unique and diverse, and despite "species" differences it is adjusted to the production of similar or identical end-products useful to the host animal or its flora.

A sheep rumen bacterium has been shown to produce an internal polysac-

charide (ISS) of the amylopectin type from numerous carbon compounds. Conditions governing the formation and utilization have been studied. ISS is a polymer composed solely of glucose and is hydrolyzed by amylase preparations. The bacterium utilizes ISS only when it is within the living cell but cannot do so when it is external to the cell. ISS is identical to that produced by the mixed rumen flora. The significance of such reactions to the evolution of the ruminant flora is considered.

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Low-Temperature Studies of Reduced Hemoproteins

The visual spectroscopic observations of Keilin and Hartree [*Nature* **164**, 254 (1949)] on the influence of low temperatures on the spectral characteristics of reduced hemoproteins has prompted the development of a technique whereby spectrophotometric recordings can be obtained of samples of hemoproteins cooled to the temperature of liquid air. The method has been applied to the study of both soluble and particle-bound cytochromes.

The main advantages of the technique are the the sharpening and intensification of the α and β absorption bands of the reduced pigments. The resulting spectra have shown that there is a threefold increase in the number of α and β absorption bands of reduced heart-muscle cytochrome *c* at low temperatures. Previously unrecognized differences in the location and number of absorption bands of reduced purified cytochrome *c* from yeast, photosynthetic bacteria, and heart muscle have been determined.

Of principal importance is the application of the technique to the resolution of the absorption bands of reduced cytochromes *b*, c_1, and *c* in heart-muscle particles, liver mitochondria, fly sarcosomes, and yeast. At liquid-air temperatures the main α absorption bands of reduced cytochromes *b*, c_1, and *c* are located at 560, 554, and 549 mμ, respectively. Since the low-temperature technique is the only method of determining the relative concentrations of cytochromes *c* and c_1, it has served as a foundation for experimentation designed to determine the role of cytochrome c_1 in biological oxidations.

One of the more interesting facets of the low-temperature studies is the application of the technique to an investigation of the formation of cytochromes *b*, c_1, and *c* during adaptation of anaerobically grown baker's yeast to aerobiosis. The transition from a double α band structure of cytochrome b_1 to the three-banded structure of cytochromes *b*, c_1, and *c* has been clearly shown to be correlated to the ability of the adapting yeast to utilize oxygen.

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Ion Transport in Plants

The absorption of ions by plant cells is the most widespread instance of active ion transport in the biological realm. In land plants, the roots are the tissue directly exposed to a medium containing inorganic nutrient—and other—ions, and the absorption of ions by the roots of higher plants has long been intensively studied. Since higher plants furnish most of the food of beast and man, they are also our own main source of needed minerals.

Active ion transport in roots is by carriers. The carriers operate across membranes not permeable to free ions. At the outer surface of the membrane, the ions are attached at specific sites of the carriers, the complex so formed traverses the membrane, and the ions are then released in a rate-limiting, largely irreversible step to "inner" spaces. Once transported into the "inner" spaces of the cells, the ions are no longer subject to ready loss by diffusion or exchange.

Since active transport seems to result in a largely irreversible trapping of the absorbed ions in the "inner" spaces of the cells of the root, the question arises how the ions can pass through the tissue and on to the shoot. Recent evidence strongly suggests that passage through the tissue is not, in fact, by way of the metabolic carrier mechanism but bypasses it. About 23 percent of the volume of barley roots and similar percentages of the roots of other species are freely and reversibly accessible to inorganic ions by diffusion and ion exchange. This volume—the "outer" space of the tissue—appears to be the pathway of the ions through the root tissue to the shoot.

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Effect of Oxygen on the Stability of Geologically Important Iron Silicates

The stability fields of silicate are usually defined in terms of temperature *T* and hydrostatic pressure *p*. A large number of geologically important silicates contain iron as a major constituent, either as Fe^{+2} replacing Mg^{+2}, or as Fe^{+3} replacing Al^{+3}. For the stability of such minerals, the partial pressure of oxygen (p_{O_2}) must be considered as an additional variable. The size of its effect has now been determined for an important test case. A newly designed technique employing platinum as a semipermeable membrane makes it possible to regulate the exceedingly small (10^{-14} to 10^{-24} atm) p_{O_2} involved in hydrous systems at temperatures up to 1000°C and pressures up to several thousand bars.

The stability of ferrous biotite, an important member of the mica family, was determined in isobaric sections by varying *T* and p_{O_2}. It was demonstrated that different breakdown products are obtained in different p_{O_2}-*T* regions. At low p_{O_2} the products of decomposition are fayalite + leucite + kalsilite + vapor, at intermediate p_{O_2} they are sanidine + magnetite + vapor; and at high p_{O_2} they are sanidine + hematite + vapor. It was also clearly shown that for one and the same reaction the equilibrium temperature *T* depends very strongly on the magnitude of the p_{O_2}, if a transfer of oxygen is involved in the reaction. At 2000 bars total pressure, the upper stability limit of the synthetic biotite varies from 620° to 805°C for a p_{O_2} varying from 10^{-20} to 10^{-30} atm.

The demonstration of the pronounced effect of oxygen on iron-bearing hydrous systems is important to the geologist, because a large number of rock-forming processes involve redox reactions. It is now possible to study such reactions quantitatively at high pressures and temperatures. The data for the test mineral biotite are significant in particular, because they fix the *p*-*T* range for the mineral assemblages of rocks belonging to the pyroxen-hornfels facies, the granulite facies, and the charnockites.

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Distribution of "Motor" Functions in the Cerebral Cortex in the Conscious Intact Monkey

Classically the "motor" functions of the cerebral cortex are placed in and restricted to the "precentral motor cortex," anterior to the central sulcus. This view has persisted despite some evidence in the literature that "motor" functions are more widely distributed in the cortex (Schäfer, Walker and Weaver, and von Bechterev).

By means of stimulations of unanesthetized monkeys' cortices through implanted electrodes, it can be shown that most (if not all) of the cerebral cortex can produce motor effects at approximately the same threshold value of stimulating electric current. By means of arrays of electrodes packed at intervals from 1 to 2 mm apart and in total numbers from 25 to 610 in a given animal, it is shown that there are no "silent" areas in the cortex; every area produces a movement.

In any classical "sensory" region, the elicited movements are such as to direct the sense organ for that region in a specific direction—that is, in the acoustic area detailed ear movements are evoked; in the visual areas, conjugate eyes and head movements; in the tactile regions, somatic movements. In all areas but two the activity elicited was restricted to contralateral movements; in the face and the spinal column areas, bilateral asymmetrical movements are elicited; the latter region is the only cortical one from which general excitement of the whole animal can be evoked. It is suggested that the cerebral cortex in each and every small area is "sensorimotor" rather than either "sensory" alone or "motor" alone; the precentral region up to the frontal pole is a predominantly efferent system, whereas the postcentral regions belong to a predominantly afferent system.

John C. Lilly
National Institute of Mental Health

Quantum Theory of Nuclear Collective Oscillations

One of the principal goals of nuclear physics is to understand the nature of the states of internal agitation into which nuclei can be brought by experiments in the laboratory. The most striking feature, that the states occur only for certain discrete energies of excitation, can be derived from the most basic principles of quantum mechanics. Quantitative application of quantum mechanics to the stationary states of the nuclei has, however, been less direct and much less satisfactory. A general difficulty is that working from first principles, one predicts fewer low-lying excited states than are experimentally observed.

We have recently reexamined this question and have found [with W. M. Visscher, *Phys. Rev.* **102**, 450 (1956)] that, although most of the states are high-lying, there are also a few low-lying ones which are probably sufficiently abundant to account for the observed energy level spectra. These states are of a special collective nature. The simplest is the so-called "breathing mode" of oscillation, which may correspond to the first excited state of O^{16}.

Our previous estimate of the energy required for this type of excitation was necessarily very rough, since it involved subtracting two large numbers. A related method used [P. S. Zyrianov and V. M. Eleonskii, *J. Exptl. Theoret. Phys. U.S.S.R.* **30**, 592 (1956)] to treat quantum mechanically the collective oscillations of an electron plasma can also be applied to the present problem and yields greatly improved accuracy.

RICHARD A. FERRELL
University of Maryland

Deuterium-Hydrogen Fractionation during Freezing of Water

Laboratory experiments show that during the freezing of water, deuterium and oxygen-18 concentrate in the ice phase. Deuterium enrichment was determined on samples of sea water and sea ice collected while ice was forming. An enrichment of deuterium of 1.3 percent in the ice relative to the water from which it was forming was found, compared with 1.4 percent found by freezing water in the laboratory.

Sea ice will have a salinity close to zero but a hydrogen isotopic composition that differs only slightly from that of sea water. The significance of this effect in determining the salinity-deuterium relationship of Arctic and Antarctic sea water is discussed. The isotopic composition of frozen sea water will differ greatly from that of glacial ice, and this offers a means of differentiating sea ice from ice of glacial origin.

The relatively small deuterium fractionation that occurs during the reaction ice $\longleftrightarrow$ water rules out this reaction as an important factor in explaining the deuterium depletion of snow and glacial ice. The reaction water $\longleftrightarrow$ vapor seems to be the important fractionating agent in this case.

The work was supported by the Woods Hole Oceanographic Institution and the U.S. Geological Survey on behalf of the U.S. Atomic Energy Commission, Division of Research.

IRVING FRIEDMAN
U.S. Geological Survey
ALFRED C. REDFIELD
Woods Hole Oceanographic Institution

Control of Anthocyanin Formation in Plants

The action spectra have been determined for anthocyanin synthesis (cyanidin derivatives) in turnip and red cabbage seedlings.

The action spectrum of turnip seedlings, grown in the presence of chloronphenical to inhibit chlorophyll formation, has a strong peak in the region of 7200 to 7400 A, with the principal action extending over the region of 7000 to 8000 A and no evidence of action below 6000 A. Anthocyanin synthesis has a 2-hour lag phase at 25°C after which it is proportional to light intensity. This and other findings indicate that synthesis depends on two photoreactions, those two having the same action spectrum, which are separated by one or more dark reactions. High radiant energies are required in the reaction, and the effective pigment possibly contains copper. The two photo-receptive pigments of the turnip exchange excitation energy in the region of 6200 to 6900 A.

In red cabbage seedlings anthocyanin formation is prominent in darkness but is enhanced by low-energy radiation. A strong peak of anthocyanin formation occurs in the region of 6600 A. Far-red radiation reverses the promotional effect of red radiation. Conditions affecting photocontrol in red cabbage are similar to those for the photoperiodic pigment system. In addition, irradiation at high energies (10 joule/cm^2) produces anthocyanin by the first of the two light reactions of the turnip.

STERLING B. HENDRICKS,
H. W. SIEGELMAN
U.S. Department of Agriculture

Experimental Approach to the Virotherapy of Cancer

The general aims and methods of virotherapeutic efforts are not dissimilar from chemotherapeutic attempts at treatment of cancer. In collaborative studies of cancer virotherapy by investigators of the National Cancer Institute and the National Institute of Allergy and Infectious Diseases, emphasis has been on the utilization of the newly recognized common viruses of man, such as the adenoviruses (APC-R1), and certain of the enteric viruses, such as the Coxsackie group, in experimental therapy of human epidermoid carcinoma.

In the laboratory, emphasis has been placed on the development of highly reproducible *in vivo* and *in vitro* tools, and advantage has been taken of the specific effects of certain of the viruses on epidermoid carcinoma grown in tissue culture (*in vitro*) and in the peritoneal cavity of x-irradiated and cortisonized rats (*in vivo*), the latter being a modification of Toolan's methods.

In the clinical studies, adenoviruses grown to high titer in HeLa cell tissue cultures (epidermoid carcinoma of the cervix) have been given to 40 patients with definite, sometimes extensive local destruction of cancer tissue, minimal side effects, and no ascertainable destruction of normal tissues. The effects were not complete, and in no case curative; however, they were sufficiently promising to encourage further efforts in both laboratory and clinical areas.

Laboratory studies designed to further this end—that is, to adapt certain relatively benign viruses to produce more rapid and complete oncolysis of human carcinoma *in vivo*, namely, in rats with solid HeLa tumor—have been successful. Similar efforts to achieve comparable oncolytic effects *in vivo* by utilizing successive passage material of the same virus strains in the same cells grown on glass *in vitro* have, on the contrary, not succeeded. Indeed, present evidence suggests that such *in vitro* passages reduce, rather than increase, the desired *in vivo* effects. The methods used for adapting and testing viruses with *in vivo* oncolytic properties are suitable for large-scale testing and are described in some detail.

R. J. HUEBNER, R. R. SMITH,
W. P. ROWE, R. G. SUSKIND, R. LOVE
National Institutes of Health

Internuclear Potential Functions for Bonds of Polyatomic Molecules

A simple form of a general relationship between energy and internuclear distance is applied to the bonds of a large number of polyatomic molecules. This relation has the form

$$V = De[1 - \exp(-n\Delta r^2/2r)]$$

where the parameter n is defined by the equation $n = k_e r_e / D_e$. Using known values of bond-stretching force constants determined from valence force models with known bond lengths, dissociation energies of bonds in polyatomic molecules have been calculated more accurately than was hitherto possible. The proposed internuclear potential function may be derived from a simplified quantum mechanical model with the result that application to polyatomic molecules may be made independent of any empirically evaluated parameters.

The relationship between bond dissociation energy and average bond energy as related to the proposed function is discussed. A number of other applications of this function are suggested. Limitations of the proposed function are that it does not appear to describe accurately the bond properties of some polar molecules or of bonds where the valence force model is a poor approximation to the molecular force field. With due consideration to its limitations, this function should be useful as a tool for elucidating problems of bond formation and structure.

ELLIS R. LIPPINCOTT
University of Maryland

Present Status of Research on the Physical Constants at the National Bureau of Standards

At the present time at the National Bureau of Standards, measurements at optimum magnitudes may be made in terms of our primary standards with probable errors of about 3 in 10^9 (1 kg mass), 3 in 10^8 (1 m length), 1 in 10^8 (1 sec time or more), and 3 in 10^7 (triple point temperature). Since all of these, except temperature, are presently defined in terms of prototype standards (even time in a certain sense), selected for their ready measurability and assumed stability, they may be subject to long-time changes. It is desirable, therefore, when the state of measurability permits, to define the primary standards in terms of physical constants.

Length and time can now be expressed in terms of certain physical constants with greater precision than either can be referred to the primary standards. This is accomplished through the measurement of the wavelength or light and microwave spectra of atomic and molecular systems. Great degradation in precision arises in measuring many of the other physical constants, particularly important elemental ones as h, e, and m. This comes about largely because electric standards with probable errors of 6 in 10^6 (ampere), 5 in 10^8 (ohm), 6 in 10^8 (volt), and the transfer constant g (2 in 10^6) are involved in the measurement chain.

The National Bureau of Standards has in recent years remeasured a number of important constants, including the speed of light (c), the Faraday (F), the gyromagnetic ratio of the proton (γ), the ratio of charge to mass for elemental particles $(e/m)_p$. Precise determinations of the electric standards, the acceleration of gravity (g), and extensive intercomparisons of optical wavelengths have also been completed recently.

Future plans call for remeasurement of several of these, particularly c, γ'_p, F, and the transfer constant g. In these measurements, it is hoped to achieve a probable error in the accuracy approaching 1 in 10^7 in both c and g with appreciable improvement in the accuracy of γ and F. The recent and proposed determinations are discussed.

R. D. Huntoon, A. G. McNish
National Bureau of Standards

Radiocarbon-Based Pleistocene Correlations and World-Wide Climatic Change

Radiocarbon data permit reassessment of the concept of world-wide, contemporaneous climatic history. South-central Alaska and midwest glacial chronologies are correlated with a European sequence as follows (an asterisk indicates approximate B.C. date): Eklutna-Illinoian-Saale (between 130,000 and 85,000*); Knik-"X."-Warthe (to 45,000*); Naptowne-Wisconsin-Fourth Glaciation (to 3500*), with substages pro-Moosehorn-Farmdale, Iowan-Brandenberg, Frankfurt Posen (to 17,000*), Moosehorn-Tazewell-Pomeranian (to 13,500*), Killey-Cary-Scanian (to 10,500*), Skilak-Mankato-Fennoscandian (to 7000*), Tanya-Cochrane-Ragunda Pause (to 3500*); and Alaskan-"little ice age"-(?) (after 3500*). These dated boundaries, marking culminations of interglacials and interstadials at intervals of 40,000 to 45,000 and 3000 to 4000 years, are derived from radiocarbon, varve (Degeer), depth of leaching (Kay), and astronomic ("Obliquity Cycle") calculations.

These correlations satisfy parallel sequence and indicate apparent contemporaneity of climatic trends throughout the Northern Hemisphere. However, local factors determined major differences in glacial intensity and age of maximum extent. Greatest extent of Naptowne, Fourth Glaciation, and Wisconsin glaciers was, respectively, 40,800 and 1500 miles from icecap centers and was reached at 16,500* in Illinois (Tazewell) and in Alaska (Moosehorn); 20,000* in Iowa (Iowan); and probably before 22,000* in Germany (Brandenberg). The suggested 41,000-year "Obliquity Cycle" climatic control for glacial stages involves a theoretical lag between hemispheres of about 5000 years for Wisconsin age maxima. This is less than the indicated Northern Hemisphere regional lags and underscores the fact that more critical geoclimatic data is necessary before the postulated climatic lag between Northern and Southern Hemispheres can be discounted.

Thor N. V. Karlstrom
U.S. Geological Survey

Possible Mechanism of the Accumulation of Electrolytes by Living Cells

The simultaneous accumulation of anions and cations against concentration gradients can be achieved by certain composite membranes consisting of highly cation-selective and highly anion-selective parts [K. Sollner, *Arch. Biochem. and Biophys.* **54**, 129 (1955)]. Two Donnan equilibria arise between an "outside" solution of constant composition and an "inside" solution in which the concentration of some electrolyte is kept constant, in excess of its "outside" concentration. The two membrane equilibria must be independent of each other while the solution in the two inside compartments is mixed, and while the flow of a discharging current is prevented by having, between the membranes, in the "inside" or "outside" solution an infinitely high electric resistance.

The theoretical requirements of accumulation are fulfilled also if the biologically more realistic assumption is made that the membranes represent the high resistance part of the system. The membranes may be nonconducting phases across which ions exchange by non-ionic processes, or stirred liquid phases (of suitable geometry and extremely high resistance) across which the exchange is ionic. Stirring accelerates manyfold the exchange and accumulation of ions but does not increase the conductance of the membranes or the strength of the discharging current; thus accumulation occurs.

Karl Sollner
National Institutes of Health

Some Biological Applications of the X-ray Microscope

The projection x-ray microscope of the type developed by Cosslett and Nixon has now been developed to the point where it is necessary to determine how useful this new instrument will be in the study of biological materials. A comparison is made between the results to be expected from it and from conventional contact radiography. Problems of specimen preparation are discussed and current studies of large objects at low magnifications (developing teeth and bone) and of thin sections of soft tissues are illustrated.

V. M. Mosley, D. B. Scott, R. W. G. Wyckoff
National Institutes of Health

Biological Action of Polymyxin B

The selective toxicity of polymyxin B, a natural polypeptide of *Bacillus polymyxa*, has been demonstrated in a study of its action on certain algae, bacteria, and fungi. The antibiotic is less toxic to the green algae *Scenedesmus* and *Chlorella* than to common bacteria and fungi growing with them as contaminants in nonsterile culture. The cause for this selectivity has been investigated by examining growth, respiration, and photosynthesis in the presence of various metabolic intermediates.

The inhibition of growth and respiration in the sensitive bacteria can be overcome by using lactose or galactose as the energy source. This reduction of toxicity in the presence of galactose suggests that the usual pathway of galactose assimilation through glucose-1-phosphate does not operate in these organisms unless the site of inhibition is only at the initial phosphorylation of glucose. This can be shown not to be the case, and the evidence indicates an alternative pathway not common to both glucose and galactose. Studies with polymyxin-susceptible and polymyxin-resistant strains of *Chlorella* provide further information concerning this phenomenon.

Robert W. Krauss, Raymond A. Galloway
University of Maryland

Synoptic Study of the Airglow

In earlier studies two hypotheses have been advanced concerning the form and structure of the night airglow (5577A). The first asserts that there is an intensity pattern which retains its gross features on the night side of the earth with respect to the sun-earth axes. An observer at a particular location transverses this pattern as the earth rotates during the night. The second hypothesis considers that airglow emission layer has folds which make the integrated intensity depend on the aspect of the folds with respect to the observer. In the current study four nights of simultaneous observations at Cactus Peak, Calif., and Sacramento Peak, N.M., are examined in the light of these hypotheses.

Franklin E. Roach
National Bureau of Standards, Boulder

Some Properties of Crystallized Coxsackie Virus

Coxsackie A-10 virus, grown in suckling mouse muscle, was purified by methods previously described. Several interesting characteristics of the virus were noted, among which were variation in isoelectric precipitability, dependence of stability on saline concentration, and variation in relative infectivity with route of infection, not seen with unpurified virus.

Highly infective dodecahedral or platelike crystals formed in ultracentrifugal pellets, depending on the type of salt present. Electron microscopy of pseudo replicas has revealed both rectangular and hexagonal arraying of 28-mμ particles, with angles equal to those presented by the crystal faces. Crystals are nonbirefringent, which is characteristic of crystals belonging to the cubic system. Both forms of crystal exhibit the instability seen in most virus crystals when, on drying, they disintegrate into amorphous hygroscopic residue.

Chemical analysis indicates that the virus consists of 10 percent nitrogen by weight. Preliminary, but inconclusive, pentose analysis suggests that the nucleic acid contains ribose. Quantitative, as well as qualitative, studies of pentose and purine and pyrimidine composition are in progress.

CARL F. T. MATTERN, HERMAN G. DUBUY
National Institutes of Health

Infrared Emission Spectrum of Silicon Carbide Heating Elements

The extreme temperatures encountered by modern high-speed aircraft and missiles and the importance of radiation in heat transfer at high temperatures have resulted in demands by aircraft engineers for infrared emissivity data on construction and coating materials. Some information on total emissivity is available, but this is not useful in heat-transfer calculations unless the spectral distribution of emissivity is known for both emitter and absorber. The determination of spectral emissivities involves measurements of radiation in a cavity observed through an aperture which must be very narrow if the source is to approximate a black body. The consequent narrowness of the spectrometer slit requires high amplifier gain and slow scanning of the spectrum. Hence, it is desirable to use an ordinary spectrometer source as a secondary standard for routine measurements.

A method for determining the spectral emissivity of a silicon carbide heating element (Globar) was devised, using as a primary standard an electrically heated black body consisting of a hollow carbon cylinder with a narrow slot. Data were obtained over the wavelength range from 1.25 to 15.25 μ for temperatures 900°, 1200°, 1500°, and 1800°F. The emission spectrum at all four temperatures approximates that of a gray body having an emissivity of about 0.75 between 4 and 15.25 μ, except for two shallow minima at about 9 μ and 12.5 μ. The first of these is ascribed to minor amounts of silica present on the surface of the heating element, while the second corresponds to a strong Raman line of silicon carbide. At wavelengths shorter than 4 μ the emissivity slowly falls to about 0.6 at 1.25 μ.

Using the silicon carbide secondary standard, spectral emissivities have been determined for electropolished and sandblasted specimens of stainless steel and Inconel, with oxidized and unoxidized surfaces, and for specimens of stainless steel and Inconel with certain coatings used on aircraft components.

JAMES E. STEWART,
JOSEPH C. RICHMOND
National Bureau of Standards

On the Estimation of Physical Quantities

This paper presents an account of recent research on partial differential equations carried out at the University of Maryland. It is concerned in particular with the estimation of important physical quantities arising in the study of electrostatic fields, incompressible fluid flow, elastic deformation, and other problems of physical interest.

Many of these problems can be reduced to the determination of a harmonic function satisfying certain boundary conditions. Consequently, for definiteness, attention is focused in this paper on methods for obtaining bounds in harmonic problems. Let u be harmonic in a region D whose boundary C is star-shaped with respect to some point, and let u or its normal derivative be prescribed on C. For such a region upper and lower bounds are obtained for the Dirichlet integral of u and for the value of u and its derivatives at a point inside D. These bounds are an improvement over those obtained previously by H. F. Weinberger and me [*J. Math. Phys.* 33, 291 (1955)].

L. E. PAYNE
University of Maryland

Precise Coulometric Titrations

A number of electrode reactions proceed quantitatively in that the amount of the reaction can be calculated using Faraday's laws of electrolysis. Coulometric titrations based on such reactions are capable of high precision and have the advantage that they employ a universal and pure reagent, the electric current. By using a constant current, which is measured precisely, integration is eliminated and the determination of the duration of the reaction is the only other measurement required.

This paper is concerned with coulometric methods of high precision and accuracy for absolute chemical determinations and for the standardization of chemical reagents. The apparatus, consisting of current source, instrumentation for measurement of current and time, and electrolysis cells designed to separate the anode and cathode to prevent interaction of the respective electrode reactions, is described in detail. The factors that affect the precision and accuracy of the method are considered. The technique is illustrated by a discussion of acidimetric and redox titrations with precision of about 0.01 percent investigated in this laboratory.

JOHN K. TAYLOR, STANLEY W. SMITH
National Bureau of Standards

Biochemical Basis for the Toxicity of Pentachlorophenol

Pentachlorophenol is extremely toxic to a wide variety of organisms, including microorganisms, fungi, molluscs, and mammals. Experiments, aimed principally at uncovering an enzymatic basis for its molluscicidal activity, led to the demonstration that pentachlorophenol can interfere drastically with the biochemical energetics of the cell. Specifically, the coupling of phosphorylation to oxidation is completely inhibited by minute concentrations of pentachlorophenol in both rat and snail mitochondrial preparations. Anaerobic (glycolytic) phosphorylations are not interrupted by concentrations of pentachlorophenol that uncouple aerobic phosphorylation. The same low concentrations of pentachlorophenol that dissociate oxidative phosphorylation *in vitro* increase respiration and glycolysis in living snails.

These findings in their qualitative and quantitative aspects lend cogent support to the hypothesis that pentachlorophenol not only stimulates a compensatory mechanism of increased glycolytic activity but, in effect, fatally interferes with the organism's principal energy source. Although pentachlorophenol's uncoupling action resembles the well-known effect of 2,4-dinitrophenol, it is considerably more effective in this respect. Furthermore, pentachlorophenol possesses certain biochemical properties not shared by the nitrophenol. In contrast to the latter compound, pentachlorophenol, under certain conditions, inhibits mitochondrial adenosine-triphosphatase. Although the physiological significance of the latter enzyme remains obscure, its inhibition by pentachlorophenol may provide indirect evidence of additional profound disturbance of phosphate metabolism by the halophenol. Moreover, this toxic compound under *in vitro* conditions can effect gross change of the mitochondrial structure itself.

EUGENE C. WEINBACH
National Institutes of Health

Emission Spectra of Actinium

Small samples of actinium, produced by transmuting radium, have been investigated by photographing the spectra of light emitted by the samples when they were excited in a hollow cathode or in arcs and sparks between copper or silver electrodes. The wavelengths were measured, and intensities were estimated, for some 500 Ac lines in the spectral range 2062.00 to 7886.82 A. A comparison of line characteristics in different sources

permitted sorting into five categories; about 140 lines belong to Ac I, more than 300 were ascribed to Ac II, eight were definitely assigned to Ac III, four may belong to Ac IV, and about 80 represent band heads produced by Ac 0 molecules.

Analyses of the first three spectra of actinium have revealed their most important features, including atomic energy levels, spectral terms, and electron configurations. The ground state of Ac I is found to be $(6d\ 7s^2)\ {}^2D_{1\frac{1}{2}}$, that of Ac II is $(7s^2)\ {}^1S_0$, and that of Ac III is $(7s)\ {}^2S_{0\frac{1}{2}}$.

Comparisons of the analogous spectra of the chemical homologs (scandium, yttrium, lanthanum, and actinium) show that actinium closely resembles yttrium, except that additional terms of odd parity, first found in lanthanum spectra and attributed to the 4 *f* electron, are also found in actinium spectra where they provide evidence of the presence of the 5 *f* electron. In Ac II practically all the spectral terms arising from $7s^2$, $6d$, $7s$, $6d^2$, $7s\ 7p$, $6d\ 7p$, $5f\ 7s$, $5f\ 6d$, $7s\ 8s$, and $5f\ 7p$ have been found. From a two-member series in this spectrum an ionization potential of 12.0 ev has been derived for Ac^+ ions.

WILLIAM F. MEGGERS
National Bureau of Standards
MARK FRED, FRANK S. TOMKINS
Argonne National Laboratory

Glycogen Turnover and Metabolic Inhomogeneity

The distribution of isotopic label in glycogen of liver and of muscle has been studied after administration of glucose-C^{14} to intact animals. Labeling of glycogen has been found to be inhomogeneous in two respects. Intramolecularly, glucosyl residues are initially introduced into glycogen at the peripheral (nonreducing) termini, and only subsequently does isotope appear in the inner tiers of glycogen. The latter process is slower in muscle than in liver. Within the polydisperse population of glycogen molecules, glucosyl residues are added at differing rates to molecules of differing sizes. In muscle the larger molecules are favored over the smaller, whereas in liver the reverse is the case.

The turnover of glycogen cannot be described in terms of replacement of a preexisting molecule by a newly formed one. Rather it appears that glucose residues are continuously being added to and removed from the nonreducing ends of the treelike glycogen structure, and by secondary processes of branching and debranching residues are transformed from tier to tier. The rates of these processes are influenced by the enzyme architecture of the tissue and by the sizes of the individual macromolecules. In contrast to current speculation in regard to protein biosynthesis, no "template" mechanism is postulated in polysaccharide biosynthesis. There is no "finished" glycogen molecule, as there may be a "finished" protein molecule. The polydispersity of glycogen, in contrast to the monodispersity of many known proteins, reflects the interruption, by the experimenter, of a process of continuous growth and degradation.

DEWITT STETTEN, JR.,
MARJORIE R. STETTEN
National Institutes of Health

Structure of the Earth's Crust from Gravity Measurements

Explosion seismic measurements of typical continental structures [H. E. Tatel and M. A. Tuve, *Spec. Paper 62 Geol. Soc. Amer.* (1955), pp. 35–60] have shown surprising complexities. The simple ideas of Airy and Pratt which relate topographic heights to crustal thicknesses are not universal. The question now arises whether or not these seismic measurements are in disagreement with the results of gravity measurements. These latter have been considered to be the basis of our picture of a continental crust constructed like a large floating plate with thickness proportional to the topographic height. The answer is that the two analyses, seismic and gravity, differ not in principle, only in interpretation.

The gravity measurement can be used to demonstrate that the crust is floating. However, the isostatic reductions leave an unexplained residual, of ± 30 milligals for median height (200–1200 m) continental stations. This spread masks the difference of about 5 milligals expected for compensation computed at 30- and 60-km depths, respectively.

In mountainous regions, where there is contrasting topography, the gravity analyses are far more sensitive to the crustal depth. Even in these regions there are large unexplained anomalies. For the vast, almost level, continental regions, the values of gravity are quite insensitive to the crustal depths. Therefore, we are at present unable to determine gravimetrically, with any precision, how the depth of the crust varies over most of a continent.

HOWARD E. TATEL
Carnegie Institution of Washington

Some Relations of Later Tertiary Volcanology and Structure in Eastern Oregon

Along the southern edge of the Columbia Plateau and the northern edge of the Basin and Range province variations in Miocene volanic rocks seem closely related to patterns of deformation.

The dominant structural feature of the region is the east-west Aldrich-Strawberry Mountain range, which is partly an asymmetric anticline with the north limb vertical, and partly a south-dipping fault block. To the north, the uniform basalt flows of the Columbia Plateau were fed from fissures and deformed by east-west folds accompanied by subordinate faulting. To the south, the Miocene volcanic rocks range from olivine basalt to rhyolite, were erupted from volcanoes, and were broken by northwest-trending faults. At a few places in the volcanic border zone, plateau basalts are intercalated with basaltic andesite and rhyolite; elsewhere detailed correlation of the two lava facies is uncertain. In the zone of structural transition, 40 to 50 miles wide, the northwest-trending faults merge with the westerly trending folds in ways indicating contemporaneity, and there are indications that the plateau lavas differ significantly in composition from the average for the plateau as a whole. The correlations between different types of volcanism and deformation are believed to indicate a common control by variations in the crust and subcrustal layers.

T. P. THAYER
U.S. Geological Survey

Recent Theoretical Results in the Propagation of VLF Radio Waves

The recent availability of extensive experimental data on the propagation characteristics of very-low-frequency waves has prompted a renewed look at the theory. Some aspects that have been considered are the extension of geometric optics to include diffraction effects, the wave-guide mode theory, the effect of the earth's magnetic field, the propagation of ground waves across a coastline, and related transient phenomena. The essential features and conclusions of these investigations are described.

JAMES R. WAIT
National Bureau of Standards, Boulder

Stereochemical Studies of Building Stones of Collagen

With our increasing understanding of the architecture of the collagen molecule, the exact configurations of the two typical building stones, the open hydroxyamino acid δ-hydroxylysine (I) and the cyclic 4-hydroxyproline (II) become a matter of importance. Four approaches are presently available to this end. (i) Cyclization of I to normal (and allo) 5-hydroxypipecolic acid (III), which is a new naturally occurring amino acid and is the configurational ana- and homolog of II. (ii) Cyclization of the dibenzoyl derivative of I to a lactone and application of Hudson's lactone rule to the rotations of the lactone and open acid. (iii) Complete x-ray analysis of the two diastereoisomeric *cis*- and *trans*-*p*-iodobenzoyl lactones of I. (iv) Stereoinductive reduction of the optically active keto-analogs of I, II, and III with metal hydrides to give preferentially one reduction product. The available evidence favors the L-*erythro* configuration for I.

B. WITKOP
National Institutes of Health

Book Reviews

Currents in Biochemical Research 1956. David E. Green, Ed. Interscience, New York, 1956. 697 pp. Illus. $10.

The first volume of CBR was published 10 years ago, and this collection of 27 essays follows in the pattern set by that volume. The object of the book, according to the editor, is "to communicate to non-specialists an over-all impression of the present status of the significant problems in each field, to point up the broad strategy of current research, and . . . to speculate on the likely paths of future research." The authors "have been asked to write as simply and as lucidly as the requirements of scholarship tend to permit." Certainly, most of these objectives have been realized in many of the papers in the current collection.

By far the largest number of papers are concerned with various aspects of the chemistry and biochemistry of enzymes. Racker writes on enzymes as reagents, Mahler on enzyme complexes, Greenberg on multiple enzyme systems, and Chance on electron transfer and enzyme substrate compounds. The kinetics of enzyme reactions are discussed by Alberty, and Theorell is concerned with the relations between prosthetic groups, coenzymes, and enzymes. The role of nucleotides and coenzymes in enzymic processes is considered by Huennekens, while George discusses the nature of the reactions involving hemo proteins.

A second group of essays may be considered as primarily concerned with problems in intermediary metabolism. Cori discusses the integration of our information concerning enzymic activities with specific details of cellular organization, with particular reference to certain aspects of carbohydrate metabolism. Lipmann contributes a short paper on the basic biochemical aspects of the biological problems of "duplication, reproduction, and individualization" brought together under the term *patternization*. Steroid biosynthesis is discussed by Bloch, and the recent information in regard to the biosynthesis of the porphyrin molecule by Shemin. Leloir writes on the interconversion of sugars in various living systems.

Three papers are concerned primarily with microbiological subjects: that of Barker on bacterial fermentation, that of Snell on the role that the study of bacterial nutrition has played in our understanding of the nutritional requirements of higher animals, and an extended paper of Spiegelman and Campbell on the formation of induced enzymes in microorganisms. Current ideas concerning protein structure are discussed by Low and Edsall, while the specific problem of the structure of insulin is reported on by Sanger.

In addition to these, Morales and Botts present a theory for the primary events in muscular activity, and Nachmansohn and Wilson discuss recent work in the biochemistry of nervous activity. A new concept for the role of the ribonucleic acids is the subject of the essay by Cohn, and there are papers on photosynthesis by Bassham and Calvin and on viral growth by Hershey. Last, but not of least importance, are a number of papers concerned with the biochemical aspects of human disease, notably, a discussion of certain anomalies in carbohydrate metabolism by Stetten, of the hormones by Pincus, of the nature and function of blood by Surgenor, and the outline of an integrated concept of carcinogenesis by Rusch.

All of these papers have been prepared by experts in their various fields, although in some instances numerous details and turbid rhetoric make difficult going for the nonspecialist. However, most of the articles are stimulating as well as informative, and the book should have value, especially in affording the orientation toward a given field that is engendered by experienced guidance.

E. A. Evans, Jr.
Department of Biochemistry, University of Chicago

Handbuch der Physik. vol. XIV, *Low Temperature Physics*, 1. S. Flugge, Ed. Springer, Berlin, 1956. 349 pp. Illus.

Volume XIV of the new *Handbuch der Physik* is the first of two volumes dealing with low-temperature physics. It comprises two articles on liquefiers and associated topics, together with one each on electrical conductivity, thermal conductivity, and specific heats.

The first chapter, "The production of low temperatures down to hydrogen temperatures" by J. G. Daunt, is an impressively exhaustive summary of the principal cryogenic devices that have been developed, with much detail on design and performance. The theory of liquefiers, regenerators, and heat exchangers is outlined with the maximum thoroughness permissible under the necessary limitations of space. It is, incidentally, the longest chapter, with more than 100 pages and 101 figures. Each section is fully supplemented by references to the original articles, some of which are quite obscure and indicative of the great effort that has been put into achieving a thorough coverage of the subject. A minor criticism can be leveled at the numerous printing errors. In addition, the author obviously has divided loyalties in the matter of Anglo-American spelling, a problem that arouses my deepest sympathy.

Complementary to the first, the second chapter, by S. C. Collins, deals with "Helium liquefiers and carriers." The author discusses in turn the principles of refrigeration, heat exchangers, representative liquefiers, and transfer and storage vessels. The section on liquefiers suffers from overcondensation in the closing stages and tends to degenerate thereupon into a brief recitation of performance figures for the better-known liquefiers throughout the world. Viewed as a whole, however, the article is a valuable contribution to the volume and is amply provided with diagrams and references.

The subject of "Electrical conductivity of metals and alloys at low temperatures" is expertly dealt with by D. K. C. MacDonald. The style is refreshingly lucid and articulate, and indeed the author permits himself to become positively lighthearted on occasion. The opening section proceeds from the early history to a quick survey of theoretical developments and a discussion of the effects of impurities, lattice defects, and so on. The second part is concerned with experimental methods and techniques, especially recent developments for greater precision of measurement. The galvanometer amplifier, in the development of which the author has played an active part, is described at considerable length; other topics are measurements with bridges and potentiometers; the superconducting galvanometer, modulator, and reversing switch; and the preparation of specimens. Finally, the author returns to a discussion of the adequacy (or otherwise) of theory in the light of experimental data, concentrating on the monovalent metals, which are his principal personal interest, and ranging over the Bloch-Gruneisen formula, electron screening effects, magneto-resistance, size effects, low-temperature resistance minima and thermoelectricity, and the

anomalous skin-effect. The phenomenon of superconductivity is brought up in the discussion of electron-lattice interaction at various stages of the article but is not discussed in detail.

There are few fields of physical research in which the observations are so critically dependent on the precise state and composition of the subject material as the "Thermal conductivity of solids at low temperatures," the topic handled in this volume by P. G. Klemens in a monumental treatise. As the author so aptly states at one point, "these observations yield a conflicting picture. . . ."! But this is not to disparage the article, which, although lengthy (more than 80 pages) and hard to digest at one sitting, is rendered so mainly by the complicated nature of the subject. The latter is graphically demonstrated.

Methods of measurement are disposed of rapidly in a brief introduction. The theoretical coverage is much more extensive than is the case for the companion chapters, and most (if not all) of the available experimental data are brought into the subsequent discussion. Separate sections are devoted to dielectric solids, the electronic component and the lattice component for metals and alloys, and superconductors. In the dielectrics section, the discussion ranges over lattice waves and the phonon gas, anharmonicity effects, scattering by static imperfections, paramagnetic solids, and liquids. For the metallic state, the major difficulty lies in the separation of the electronic and lattice contributions, each component playing a dual role of carrying and scattering agent. The author ably demonstrates both the substantial advances that have been made toward, and the difficulties that remain to limit, a full understanding of the problem. Although the situation for superconductors appears at first sight to involve only additional complications, it is probable that experiments in this area will go some way toward providing a means of achieving the desirable separation of factors.

The value of the references has been enhanced by a subject title for each one. This has been carried a stage further, namely, by supplying a brief abstract, in the "General references" at the end of the ensuing article by P. H. Keesom and N. Pearlman on "Low temperature heat capacity of solids." These authors favor the alternative style (also adopted by MacDonald) of achieving greater "readability" through less detailed (but quite adequate) coverage of theory and greater over-all brevity. (A full theoretical discussion appears in volume VII of the *Handbuch.*)

A useful section on experimental techniques precedes that on experimental results, which constitutes the major portion of the article. The lattice and electronic specific heats of the elements are dealt with in the framework of the groups of the Periodic Table, including a short discussion of the transition metals and their alloys. A section on "other sources of heat capacity" deals with superconductivity (fairly detailed), excitation modes (Schottky anomalies), cooperative phenomena, and size effects (surface contribution).

The volume as a whole will be of great value to all physicists engaged in solid-state research, and it is therefore most unfortunate that the price (about $18) is so prohibitively—even unreasonably—high. One hopes, too, that the many typographic errors will be eliminated from subsequent printings. If the long-suffering English language is subjected to occasional violations throughout, this is only the modern expectation. At least one new word—*definitory*—has been boldly invented; its discovery we leave as an exercise for the reader.

R. P. HUDSON
National Bureau of Standards

Eléments de Mécanique Quantique. Ph. Pluvinage. Masson, Paris, 1955. 547 pp. Illus. Cloth, F. 4600; paper, F. 4000.

This is a first course in quantum mechanics, which might be compared with a recent American book like Schiff's or one of more ancient vintage, such as Pauling and Wilson. The author does not go into any detailed exposition of the more fundamental and more philosophic aspects of quantum theory such as might be found in Bohm's book. His intent is rather to present the formal and technical aspects of the theory as clearly as possible.

On the whole, the treatment is traditional and does not contain many of the more recent methodological developments, although there is a short section on effective range theory and the Schwartz theory of the delta function. On the other hand, every discussion does contain nontrivial physical examples of modern interest. Each new area to be considered is prefaced by a discussion of its classical limit, a technique that makes for a very clear exposition.

The material covered includes one-dimensional motion, wherein the usual concepts of quantum theory, such as energy levels and reflection coefficients, are introduced and applied to the traditional examples—that is, harmonic oscillator, square well, and so on. Matrix methods and approximate procedures then follow. Three-dimensional problems involve energy-level problems, such as the hydrogen atom and scattering problems, spin, and the Zeeman effect. The final sections of the book are devoted to the many-body problem, being devoted principally to the theory of atomic spectra and diatomic molecules. The last chapter discusses radiative effects determined by correspondence-principle methods.

HERMAN FESHBACH
Massachusetts Institute of Technology

Faster, Faster. A simple description of a giant electronic calculator and the problems it solves. W. J. Eckert and Rebecca Jones. McGraw-Hill, New York, 1955. 160 pp. Illus. $3.75.

This excellent book which, as its subtitle states, is "a simple description of a giant electronic calculator and the problems it solves" should be of interest both to those familiar with computers and to those who would like to learn something about them. It describes the Naval Ordnance Research Calculator at Dahlgren, Virginia, in detail and in terms that should be understandable even to those not in the computer field. The book describes the logical and arithmetic structure of the NORC, its auxiliary units, built-in mathematical checks, maintenance, and how to program for it; there is also an excellent chapter on why such large and fast computers are needed.

The authors only once used the generally preferred word *computer* instead of *calculator* in referring to "the first large-capacity electronic computer" as the SSEC instead of the ENIAC! A second minor flaw is the omission of a bibliography for those who become interested in learning more about electronic computers.

WILLIAM W. YOUDEN
National Bureau of Standards

Cryptococcosis. Torulosis or European blastomycosis. M. L. Littman and Lorenz E. Zimmerman. Grune & Stratton, New York and London, 1956. 205 pp. Illus. $8.50.

This is a comprehensive review of what is known about cryptococcosis and its etiologic agent. The carefully edited text covers in a very readable manner all aspects of the disease in man and animals, with special emphasis on clinical matters and pathology. Also, the cultural and morphologic characteristics of the fungus, *Cryptococcus neoformans,* are presented in detail, with a clear treatment of laboratory identification and differentiation of the pathologic species.

In addition, the writers have done a monumental job in reviewing the literature and abstracting in detail more than 500 pertinent publications. The opinions in general have been carefully evaluated and are especially significant because of the authors' extensive firsthand experiences with many phases of the disease and the associated fungus. As a result of this experience, much unpublished material has been included. Although there may not be complete agreement with all the opinions expressed in the monograph, the various views on a particular subject are usually presented, thus enabling the reader himself to examine critically the controversial points.

One of the notable features of the monograph is the inclusion of many excellent photographs, some in color, of pathologic specimens, mostly from the Armed Forces Institute of Pathology. These serve as excellent supplements to the text.

The book may be weak in suggesting future lines of research. Nevertheless, it is as a whole so well done that one must look forward with interest to the forthcoming monograph on the other systemic mycoses announced in the preface.

S. B. SALVIN

U.S. Public Health Service,
Rocky Mountain Laboratory

MARGARITA SILVA

Department of Dermatology,
Columbia University College of
Physicians and Surgeons

New Books

Physics for Everybody. Germaine and Arthur Beiser. Dutton, New York, 1956. 191 pp. $3.50.

The Origins and Prehistory of Language. G. Revesz. Translated by J. Butler. Philosophical Library, New York, 1956. 240 pp. $7.50.

Engineering Mathematics. Kenneth S. Miller. Rinehart, New York, 1956. 417 pp. $6.50.

Microscopium. Communication No. 95. Maria Rooseboom. Museum for the History of Science, Leiden, 1956. 59 pp.

The Organization of the Cerebral Cortex. D. A. Sholl. Methuen, London; Wiley, New York, 1956. 125 pp. $4.25.

Milton and Science. Kester Svendsen. Harvard University Press, Cambridge, 1956. 304 pp. $5.50.

Statistische Thermodynamik. Arnold Munster. Springer, Berlin, 1956. 852 pp. DM. 138.

Parasites and Parasitism. Thomas W. M. Cameron. Methuen, London; Wiley, New York, 1956. 322 pp. $6.75.

Mathematics of Business, Accounting, and Finance. Kenneth Lewis Trefftzs and E. Justin Hills. Harper, New York, rev. ed., 1956. (1st ed. published as *Mathematics of Business Accounting,* 1947). 591 pp. $4.50.

Psychoanalysis as Science. Hixon lectures on the scientific status of psychoanalysis. Ernest R. Hilgard, Lawrence S. Kubie, and E. Pumpian-Mindlin. E. Pumpian-Mindlin, Ed. Basic Books, New York, 1952. 174 pp. $4.25. (1956 printing of 1952 ed.)

Features of Evolution in the Flowering Plants. Ronald Good. Longmans, Green, London–New York, 1956. $6.

Vision. A saga of the sky. Harold Mansfield. Duell, Sloan and Pearce, New York, 1956. 389 pp. $5.

Annotated, Subject-Heading Bibliography of Termites 1350 B.C. *to* A.D. *1954.* Smithsonian Misc. Coll. vol. 130. Thomas E. Snyder. Smithsonian Institution, Washington, 1956. 305 pp.

Nonparametric Statistics for the Behavioral Sciences. Sidney Siegel. McGraw-Hill, New York, 1956. 312 pp. $6.50.

The Art of Architecture. Albert Richardson and Hector O. Corfiato. Philosophical Library, New York, rev. ed., 1956. 663 pp. $25.

Electronics Made Easy. Lothar Stern. Popular Mechanics Press, Chicago, 1956. 192 pp. $2.95.

The Evolution of Human Nature. C. Judson Herrick. University of Texas Press, Austin, 1956. 506 pp. $7.50.

Reports on Progress in Physics. vol. XIX, 1956. A. C. Stickland, Executive Ed. Physical Society, London, 1956. 367 pp. 210 s.

Treatise on Invertebrate Paleontology. pt. F. *Coelenterata.* Raymond C. Moore, Ed. Geological Society of America and University of Kansas Press, New York, 1956. 498 pp. $7.

Rayonnements de Particules Atomiques, Electrons et Photons. Andre Berthelot. Masson, Paris, 1956. 192 pp. F. 1800.

Précis de Géomorphologie. M. Derruau. Masson, Paris, 1956. 393 pp. Cloth, F. 3600; paper, F. 3000.

Nouveau Traité de Chimie Minérale. vol. X. *Azote-Phosphore.* Paul Pascal, Ed. Masson, Paris, 1956. 964 pp. Cloth, F. 7500; paper, F. 6600.

The Psychological Basis of Education. E. A. Peel. Philosophical Library, New York, 1956. 303 pp. $6.

Mission on the Nile. James Dempsey. Philosophical Library, New York, 1956. 204 pp. $6.

Modern Science and Human Values. A study in the history of ideas. Everett W. Hall. Van Nostrand, Princeton, N. J., 1956. 483 pp. $8.

Light-Scattering in Physical Chemistry. K. A. Stacey. Academic Press, New York; Butterworths, London, 1956. 230 pp. $6.75.

A Scientific Sampler. Raymond Stevens, Howard F. Hamacher, and Alan A. Smith, Eds. of *Industrial Bulletin.* Van Nostrand, Princeton, N.J., 1956. 413 pp. $6.

Molybdenum. L. Northcott. Academic Press, New York; Butterworths, London, 1956. 222 pp. $6.80.

The Foundations of Science and the Concepts of Psychology and Psychoanalysis. Minnesota Studies in the Philosophy of Science, vol. I. Herbert Feigl and Michael Scriven. University of Minnesota Press, Minneapolis, 1956. 346 pp. $5.

Communication. Handling ideas effectively. Roy I. Johnson, Marie Schalekamp, and Lloyd A. Garrison. McGraw-Hill, New York, 1956. 361 pp. $4.50.

Understanding Minority Groups. Joseph B. Gittler, Ed. Wiley, New York; Chapman & Hall, London, 1956. 139 pp. $3.25.

Advances in Catalysis and Related Subjects. vol. VIII. W. G. Frankenburg, V. I. Komarewsky, and E. K. Rideal, Eds. Academic Press, New York, 1956. 353 pp. $10.

Electricité. Y. Rocard. Masson, Paris, ed. 2, 1956. 613 pp. Cloth, F. 3500; paper, F. 3000.

Cours de Physique Générale. Electricité. A l'usage de l'enseignement supérieur scientifique et technique. G. Goudet. Masson, Paris, ed. 6, 1956. 899 pp. Cloth, F. 5100; paper, F. 4500.

Spectroscopy at Radio and Microwave Frequencies. D. J. E. Ingram. Philosophical Library, New York, 1956. 332 pp. $15.

Annual Review of Physical Chemistry. vol. 7. H. Eyring, C. J. Christensen, and H. S. Johnston, Eds. Annual Reviews, Palo Alto, Calif., 1956. 503 pp. $7.

Chemistry Magic. Kenneth M. Swezey. McGraw-Hill, New York, 1956. 180 pp. $4.50.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

The Distribution of Fishes Found Below a Depth of 2000 Meters. Fieldiana: Zoology, vol. 36, No. 2. 263 pp. $4. *Days with Birds.* Studies of habits of some East African Species. Fieldiana: Zoology, vol. 38. V. G. L. Someren. 520 pp. $8. *Two New Birds from Nepal.* Fieldiana: Zoology, vol. 39, No. 1. Austin L. Rand and Robert L. Fleming. 3 pp. $0.10. *A New Lacertid Lizard from Angola.* Fieldiana: Zoology, vol. 39, No. 2. Hymen Marx. 5 pp. $0.15. *A Review of the Habitat of the Earliest Vertebrates.* Fieldiana: Geology, vol. 11, No. 8. Robert H. Denison. 99 pp. $1.50.

Geophysical Activity, 1955. 25 pp. *Geophysical Activity, Interim Report to Mid-Year 1956.* 17 pp. Reports of the Standing Committee on Geophysical Activity. Society of Exploration Geophysicists, Tulsa, Okla., 1956.

Nuclear Metallurgy. vol. III. IMD Special Rept. Ser. No. 3. A symposium on the effects of radiation on metals, 8 Oct. 1956. George H. Vineyard, Donald E. Thomas, and Douglas S. Billington. American Institute of Mining, Metallurgical and Petroleum Engineers, New York 18, 1956. 54 pp. $3.75.

A Manual for Coding Organic Compounds for Use with a Mechanized Searching System. 55 pp. *A Manual for Programming Computers for Use with a Mechanized System for Searching Organic Compounds.* 23 pp. A. Opler and T. R. Norton. Dow Chemical Company, Pittsburg, Calif., 1956.

Snow Hydrology. Summary report of the snow investigations. North Pacific Division, Corps of Engineers, U.S. Army, Portland, Ore., 1956. 437 pp.

Meetings and Societies

Proposed Change in AAAS Constitution

For a number of years the American Association for the Advancement of Science has elected some scientific societies as affiliates and others as associates. The Association's Committee on Affiliation and Association recommends that the category of associates be dropped and that associated societies be offered the status of affiliates. To accomplish this change, it will be necessary to make a few changes in the Association's constitution:

1) Change the title of Article VIII from *Affiliates and Associates* to *Affiliated and Participating Organizations.*

2) Delete Section 3 of Article VIII.

3) Change the number of Section 4 of Article VIII to Section 3.

The Board of Directors approves these recommendations. They will be submitted to the Council for vote at the 1956 annual meeting in New York.

Geological Congress

Nearly 3500 *congresistas* gathered in Mexico City, 4–11 Sept., for the 20th International Geological Congress. Scientists from some 70 countries were represented at the meeting, which was formally opened by words of welcome from the President of the Republic of Mexico, Adolfo Ruiz Cortines.

Listed in the program were more than 900 papers, of which about half were read by title. The program featured symposia on oil and gas, manganese, geochemistry, and the Cambrian system. As is usually the case, the presentation of scientific papers at the congress shared the limelight with the field excursions. In the weeks before and after the congress, 32 field excursions to all parts of Mexico afforded the visiting geologists an opportunity to become acquainted with the geology and mineral deposits of the country.

The International Geological Congress is reportedly the oldest international congress of scientists, having first met in 1878. It has remained an informal union, without a permanent organization, although some consideration has been given in recent years to a permanent international union of geologists. The council of delegates, meeting in Mexico City, proposed a commission on international abstracts to be headed by H. M. B. Schurmann (the Netherlands). Other projects approved were a tectonic map of the world, a metallogenetic map, and a study of geobioclimatological problems.

The council accepted an invitation to meet in Copenhagen, Denmark, in 1957, at which time Denmark will be assisted by Iceland, Norway, Sweden, and Finland, for it is anticipated that field excursions will include the Scandinavian countries. An important development was the appointment of a committee headed by Rhodes W. Fairbridge (Columbia University) to facilitate the exchange of scientific data with geologists of the U.S.S.R. Simultaneous translation into the six official languages of the congress was used to great advantage in the council of delegates.

The Mexican hosts planned a very interesting program for the visiting geologists, many of whom were accompanied by their wives, and almost everyone found time for some sightseeing in the vicinity of Mexico City.

ROBERT C. STEPHENSON
American Geological Institute, Washington, D. C.

Moving Frontiers of Science

"Moving frontiers of science" will be the theme of the AAAS general symposium at the coming New York meeting. The afternoons of 27 and 28 Dec. will be devoted to a discussion of the fundamental units and concepts of science. Representatives of the physical, the biological, and the social sciences will analyze their own areas of science in terms of the fundamental units, variables, or concepts with which each is concerned. Because these special sessions will be of Association-wide interest, there will be no conflicting programs of the separate AAAS sections, and most of the 55 participating societies with programs have also been able to keep these two afternoons free.

The program on the afternoon of 27 Dec. will open with a brief panel discussion that is expected to point out some of the topics that will be considered by later speakers and to raise questions concerning the differences in what constitute fundamental units or concepts of different fields of science. Members of the panel will be Paul Weiss of the Rockefeller Institute for Medical Research, Paul F. Lazarsfeld of the department of sociology at Columbia University, and Jerome B. Wiesner, director of Electronics Laboratory, Massachusetts Institute of Technology.

Following the opening panel discussion will be four addresses, the first three by spokesmen for the physical, biological, and social science areas: Jerrold R. Zacharias, professor of physics and head of the laboratory of nuclear science at Massachusetts Institute of Technology, will represent the physical sciences; R. W. Gerard, of the mental health research institute of the University of Michigan, will represent biological science; and Robert B. MacLeod, Sage professor and formerly chairman of the department of psychology at Cornell University, will represent social science.

The fourth address will be by Michael Polanyi, professor of social studies at Victoria University, Manchester, England, and formerly member of the Kaiser Wilhelm Institute for physical chemistry and professor of physical chemistry at Victoria University, who will compare and contrast the positions taken by the representatives of the three broad areas of science.

The program will end with a panel discussion that will include the three original panelists and the four speakers and will provide an opportunity for the consideration of selected questions that may be presented from the floor. Chairman and moderator will be Howard Mumford Jones, chairman of the American Council of Learned Societies, Washington, D.C.

The program was arranged by the Committee on AAAS Meetings and the secretaries of the AAAS sections. Meeting together last spring, the committee and the section secretaries decided that at each annual meeting—for as long as the idea seems to be a good one—there should be one or more special sessions for the Association as a whole. The title "Moving frontiers of science" was adopted for these sessions, which, after this first year, are planned to consist of reports of research trends and findings that are of such broadly ramifying nature as to be of concern to many branches of science. The special program on fundamental units and concepts of science was planned to start the new series of programs.—RAYMOND L. TAYLOR.

Meeting Notes

The biology section of the New York Academy of Sciences is holding a conference on subcellular particles in the neoplastic process, 19–20 Nov. Participants from abroad include: P. B. Medawar, University College, London, England; P. R. Peacock, Royal Beatson Memorial Hospital, Glasgow, Scotland; and A. Graffi, Institut für Medizin und Biologie, Deutsche Akademie der Wissenschaften zu Berlin, Germany.

The biology section is also sponsoring a conference on the role of iodine-131 labeled proteins in biology and medicine on 30 Nov. One of the visitors at this meeting will be A. S. MacFarlane of the Medical Research Council, National Institute for Medical Research, London, England, who will be chairman of the methodology session.

■ The Thomas Alva Edison Foundation has announced the seventh Edison Foundation Institute, which will have as its theme "Strengthening science education for youth and industry." The conference will hold special panel sessions on "Factors in the early motivation of scientists," "The science education possibilities in cooperative education," "Science education in Russia: the qualitative aspect," and "Dilemmas of science." The meetings will take place in West Orange, N.J., 19–20 Nov.

Approximately 150 specialists will participate in the institute to formulate ways and means of solving the critical problems of science education. The speakers include Hyman G. Rickover, chief of the Naval Reactors Branch of the Atomic Energy Commission; Charles F. Kettering of the General Motors Corporation; Carroll V. Newsom, president of New York University; Alan T. Waterman, director of the National Science Foundation; Reuben Gustavson, director of Resources of the Future; George G. Brown, dean of the College of Engineering at the University of Michigan; George Kirby, vice president of research and engineering for the Ethyl Corporation; Everett T. Welmers, chief of dynamics for the Bell Aircraft Corporation; Nicholas DeWitt of the Russian Research Center at Harvard University; and Governor Charles Edison, honorary president of the Edison Foundation.

■ The ninth annual College-Industry Conference, sponsored each year by the relations-with-industry division of the American Society for Engineering Education, will take place 30–31 Jan. at the University of California, Los Angeles, under the auspices of University Extension and U.C.L.A. College of Engineering. The conference, which is being held on the West Coast for the first time, will have as its theme, "Improvement of the engineer—a dual responsibility of industry and the engineering school."

Emphasis throughout the meeting will be on improvement of the engineer rather than on the training of more engineers. Among the speakers already scheduled are C. C. Furnas, Assistant Secretary of Defense in charge of Research and Development; J. L. Young, executive vice president for engineering, U.S. Steel Corporation; G. A. Hawkins, dean of engineering at Purdue University; and C. J. Freund, dean of the College of Engineering at the University of Detroit.

■ The second International Congress of Photobiology will be held in Turin, Italy, 2–8 June 1957. The program will consist of four symposia: (i) biological effects of radiation longer than 3200 A (especially long ultraviolet); (ii) vision and light quanta; (iii) dermatoses produced by light and their photoallergic basis; and (iv) photoreceptors in biology. A number of invited lectures and contributed papers will be given. For detailed information concerning abstracts, reservations, and so forth, write to the local secretary general, Prof. Giuseppe Matli, Instituto di Fisica dell'Universita di Torino, Via Pietro Giuria 1, Corso Massimo d'Azeglio 46, Turin, Italy.

Society Elections

■ Western Section of the American Society of Plant Physiologists: chairman, Myron Stout, U.S. Department of Agriculture, Salt Lake City, Utah; v. chairman, N. Higinbotham, State College of Washington, Pullman; sec.-treas., John D. Spikes, University of Utah.

■ Paleontological Research Institution: pres., S. C. Hollister; v. pres., Norman E. Weisbord; sec.-treas., Rebecca S. Harris.

■ Reticuloendothelial Society: pres., Leon Jacobson, University of Chicago; v. pres., Lewis Thomas, New York University; sec.-treas., John Heller, New England Institute for Medical Research.

■ South Carolina Academy of Science: pres., I. S. H. Metcalf, The Citadel; v. pres., H. W. Davis, University of South Carolina; sec.-treas., Margaret Hess, Winthrop College. Representative to the AAAS Council is J. G. Dinwiddie.

Forthcoming Events

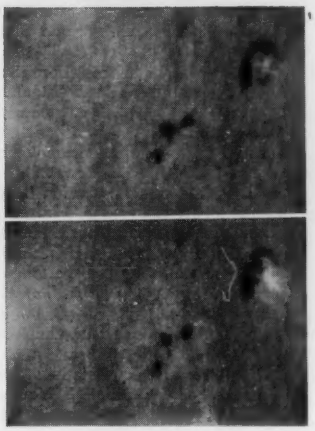
December

8–11. **American Acad. of Optometry, annual, Houston, Tex. (C. C. Koch, 1506 Foshay Tower, Minneapolis 2, Minn.)**

Kodak reports to laboratories on:

films for those engaged in advanced photographic exercises and those who are not . . . watching a tail-lash at leisure . . . films for dosimetry

Sun and grain

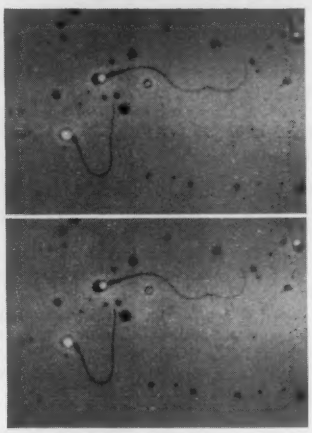


These two frames of movie film were taken ⅛ second apart. These are part of a cine record of a sunspot made on August 11, 1954, at the RCA Solar Observatory, Rocky Point, N. Y. When one computes how fast the "flare" has moved in the ⅛ second, one is inclined to attribute the apparent motion to excitation rather than to transport of actual material at a velocity of 50,000 kilometers per second.

Since Dr. William A. Miller was photographing the face of the sun itself, getting enough light on his film was the very least of his problems. He could therefore afford to choose *Kodak Spectroscopic Film, Type 548-GH*, in which the balance between light sensitivity and resolving power is weighted overwhelmingly in favor of the latter. (Only *Type 649* is slower and finer-grained than *Type 548*.)

Anyone else who can afford so prodigally to trade film sensitivity for fineness of grain can make arrangements for a supply of Kodak Spectroscopic Film, Type 548-GH (*or even* Type 649), *by writing to Eastman Kodak Company, Special Sensitized Products Sales, Rochester 4, N. Y. The same emulsion on glass can be ordered directly from Kodak dealers as* Kodak High Resolution Plates. *Frankly, though, if you are not making photographic reticles or engaging in other advanced exercises, and if you need practical camera speed along with the finest grain that can accompany it, your best bet is to pick up a few rolls of the new* Kodak Panatomic-X Film *at the nearest film counter.*

Time and light microscopes united



These two photomicrographs were taken 1/500 second apart through a phase microscope at 105× magnification of objects some 400 billion times smaller than the sunspots in the adjoining column. We made some 4,000 such photomicrographs in a recent 8-second span of time. By projecting the pictures at the usual 16 frames per second, it became possible for the first time to watch at leisure how spermatazoa whip their tails.

This was done by attaching to the light microscope a powerful time magnifier, the *Kodak High Speed Camera*. Also, it was the unprecedented sensitivity of *Cine-Kodak Tri-X Film* that permitted a light level that such heat-sensitive subjects could survive long enough to be photographed.

Now we wonder what else can be done with high speed movies through the microscope that would be worth the price of a *Kodak High Speed Camera* ($1713.50). Protozoology, perhaps. Crystal formation?

For guidance in working out a possible alliance between this camera and your microscope, write Eastman Kodak Company, Medical Division, Rochester 4, N. Y.

Monitoring the person

As ever more men earn their daily bread by the care and feeding of nuclear reactors or the manipulation of reactor products, the time has come for us to systematize the nomenclature of the various materials we make that go into the badges worn for a working week and then turned in for recording how much radiation the worker has received.

The simplest of the materials is *Kodak Personal Monitoring Film, Type 1*, with a layer of the most sensitive of all x-ray emulsions on each side of the base. Its function, largely, is to establish that the wearer has not been exposed to more β-, γ-, or X-radiation than is considered permissible.

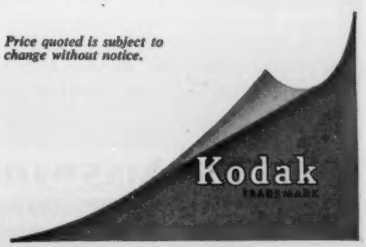
The new *Kodak Personal Monitoring Film, Type 2*, goes a step farther. *Type 2* has the highly sensitive emulsion on one side only. The other side bears a low-sensitivity emulsion that is just barely affected by exposures that drive the high-sensitivity side to full density. If the film should emerge from processing a sinister heavy black, one can quickly remove the high-sensitivity emulsion and assess the full measure of the misfortune from the density of the slow emulsion. Fortunately, this happens very seldom.

Kodak Personal Neutron Monitoring Film, Type A, is read with a microscope. One counts within a given area the number of tracks left by protons recoiling from fast neutrons or generated in the $N^{14}(n,p)C^{14}$ reaction.

Kodak Personal Neutron Monitoring Film, Type B, is a complex sandwich of NTA film between aluminum shields and paper proton radiators, all contrived to make the track counts correspond more quantitatively to the physiological effect of fast neutrons such as occur around accelerators.

Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y., quotes prices, gives hints on processing and calibration, and arranges delivery through Kodak dealers. (Secretaries to the contrary notwithstanding, the word is "personal," not "personnel.")

Price quoted is subject to change without notice.



This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are . . . *serving laboratories everywhere*

9–12. American Inst. of Chemical Engineers, annual, Boston, Mass. (F. J. Van Antwerpen, AICE, 25 W. 45 St., New York 36.)

9–12. American Soc. of Agricultural Engineers, Chicago, Ill. (J. L. Butt, ASAE, St. Joseph, Mich.)

10–12. American Nuclear Soc., winter meeting, Washington, D.C. (ANS, P.O. Box 963, Oak Ridge, Tenn.)

10–12. Eastern Joint Computer Conf., New York, N.Y. (J. R. Weiner, Remington Rand, Inc., 315 Fourth Ave., New York, N.Y.)

10–12. North Central Weed Control Conf., 13th annual, Chicago, Ill. (O. C. Lee, Agricultural Extension Service, Purdue Univ., Lafayette, Ind.)

12–14. European Assoc. of Exploration Geophysicists, Milan, Italy. (B. Baars, Carel Van Bylandtlaan 30, The Hague, Holland.)

13–15. Texas Acad. of Science, annual, Brownwood, Tex. (G. C. Parker, Texas A.&M. College, College Station.)

19. Arctic Branch, Alaska Div., AAAS, College Alaska. (Miss C. Juedes, Box 47, College.)

26–31. American Assoc. for the Advancement of Science, annual, New York, N.Y. (R. L. Taylor, AAAS, 1515 Massachusetts Ave., NW, Washington 5.)

27–28. Fluid Mechanics in Chemical Engineering, American Chemical Soc., Lafayette, Ind. (W. E. Ranz, Dept. of Engineering Research, Pennsylvania State Univ., University Park.)

27–28. Linguistic Soc. of America, Philadelphia, Pa. (A. A. Hill, Box 7790, University Sta., Austin 12, Tex.)

27–29. American Mathematical Soc., 63rd annual, Rochester, N.Y. (J. H. Curtiss, AMS, 80 Waterman St., Providence 6, R.I.)

27–29. American Physical Soc., Monterey, Calif. (W. A. Nierenberg, Univ. of California, Berkeley 4.)

27–29. Western Soc. of Naturalists, annual, Goleta, Calif. (D. Davenport, Santa Barbara College, Goleta.)

27–30. American Economic Assoc., annual, Cleveland, Ohio. (J. W. Bell, 629 Noyes St., Evanston, Ill.)

27–30. American Finance Assoc., annual, Cleveland, Ohio. (G. E. Hassett, Jr., New York Univ., 90 Trinity Place, New York 6.)

28. Society for the Advancement of Criminology, annual western, Fresno, Calif. (W. Dienstein, Fresno State College, Fresno.)

28–29. American Folk-Lore Soc., annual, Santa Monica, Calif. (MacE. Leach, Bennett Hall, Univ. of Pennsylvania, Philadelphia 4.)

28–30. American Anthropological Assoc., annual, Santa Monica, Calif. (W. S. Godfrey, Jr., Logan Museum, Beloit College, Beloit, Wis.)

28–30. American Historical Assoc., annual, St. Louis, Mo. (AHA, Study Room 274, Library of Congress, Washington 25.)

28–30. Archaeological Inst. of America, annual, Philadelphia, Pa. (C. Boulter, Library, Univ. of Cincinnati, Cincinnati 21, Ohio.)

28–30. Industrial Relations Research Assoc., Cleveland, Ohio. (E. Young, Sterling Hall, Univ. of Wisconsin, Madison 6.)

29. Mathematical Assoc. of America, 40th annual, Rochester, N.Y. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

29–30. American Chemical Soc., Div. of Industrial and Engineering Chemistry, Princeton, N.J. (A. H. Emery, ACS, 1155 16 St., NW, Washington 6, D.C.)

January

7–11. International Social Science Council, 3rd gen'l. assembly, Paris, France. (Secretary Gen'l., ISSC, 19, avenue Kleber, Paris 16.)

10. Technical and Clinical Applications of Radioisotopes, Assoc. of Vitamin Chemists, Chicago, Ill. (M. Freed, Dawe's Laboratories, Inc., 4800 S. Richmond St., Chicago 32.)

10–12. American Group Psychotherapy Assoc., 14th annual, New York, N.Y. (C. Beukenkamp, Jr., AGPA, Room 300, 345 E. 46 St., New York 17.)

14–16. Cottonseed Processing as Related to the Nutritive Value of the Meal, 4th conf., New Orleans, La. (Southern Regional Research Lab., USDA, 1100 Robert E. Lee Blvd., New Orleans 19.)

14–16. Reliability and Quality Control in Electronics, 3rd natl. symp., Washington, D.C. (C. M. Ryerson, Radio Corp. of America, Bldg. 10–6, Camden 2, N.J.)

14–18. Society of Automotive Engineers, annual, Detroit, Mich. (Meetings Div., SAE, 29 W. 39 St., New York 18.)

14–20. Indian Science Cong. Assoc., 44th meeting, Calcutta, India. (General Secretary, ISCA, 1 Park St., Calcutta 16.)

16–23. Australian and New Zealand Assoc. for the Advancement of Science, 32nd meeting, Dunedin, N.Z. (J. R. A. McMillan, ANZAAS, Science House, 157 Gloucester St., Sydney, N.S.W., Australia.)

17–18. Engineers Joint Council, New York, N.Y. (EJC, 29 W. 39 St., New York 18.)

18–19. Symposium on Blood, 6th annual, Detroit, Mich. (W. H. Seegers, Wayne State Univ. Coll. of Medicine, Detroit 7.)

(See issue of 19 October for comprehensive list)

EQUIPMENT NEWS

All inquiries concerning items listed here should be addressed to Science, *Room 604, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ WIDE-MOUTH PLASTIC BOTTLES blown from the new low-pressure type of polyethylene are now available in capacities from 1 through 32 oz. The bottles have a black, mineral-filled phenolic closure with a white rubber liner. They are fairly rigid, unbreakable, light weight, and translucent. (Nalge Co., Inc., Dept. S58)

■ VIBRATION PICKUP PREAMPLIFIER has two-stages with high input impedance that allow vibration measurements to be carried out to very low frequencies at extended distances from the measuring instrument. A built-in calibration unit affords calibration of the combination of accelerometer, preamplifier, and measuring instrument before the measurements are carried out. A set of integrating networks is provided for measurements of the velocity and displacement of the vibrations under consideration. (Brush Electronics Company, Dept. S57)

■ OXYGEN ANALYZER, a portable model D2, may be used for measuring oxygen in almost any mixture of gases. It is designed for use in such applications as measuring excess air to study combustion efficiency, monitoring leakage of air in inert systems, and insuring safe entry into sewers, mines, and vessels. The accuracy of the reading is not affected by other gases in the mixture. (Arnold O. Beckman, Inc., Dept. S54)

■ SORPTIVE MINERALS that protect platinum used as a reforming catalyst for petroleum naphthas are described in a new bulletin, "Preparation of petroleum feeds for platinum catalysts." Various minor feed constituents—for example, arsenic, tetraethyl lead, alkyl sulfur compounds, and nitrogen—that may poison the catalyst are removed by the new adsorbents. (Minerals and Chemicals Corp. of America, Dept. S56)

■ DIGITAL D-C VOLTMETER for applications requiring 3-digit measurement provides automatic measurement from 0 to 999 v, automatic polarity indication, automatic range selection, and automatic readout decimal point location. The instrument has an oil-sealed, stepping-switch system, and it presents readings in luminous, in-line numerical display. (Non-Linear Systems, Inc., Dept. S68)

■ VAPOR FRACTOMETER model 154-B is a new version of model 154. The changes include (i) an increased operating temperature range that allows for analysis of gases and liquids that boil at temperatures up to 300°C and (ii) an increase in the sensitivity of the detector. (Perkin-Elmer Corp., Dept. S73)

■ FLASK SUPPORTS for hot round-bottom flasks are made of Neoprene. The 5-in. rings are beveled to hold either a 250- or a 500-ml flask, and they do not slip on wet or dry bench tops. During storage, a ridge on the bottom of each ring interlocks with the top of the ring under it. (Fisher Scientific Co., Dept. S55)

■ STEREOSCOPIC MICROSCOPES have a numerically calibrated Magni-Changer, a cylinder containing 16 achromatically corrected optical elements. Desired magnifications are "dialed-in" by rotation of the Magni-Changer. Resultant magnifications range from × 3.5 to × 80. All models in the new Cycloptic series are supplied with inclined, reversible, binocular bodies, standard apochromatic objective, wide-field eyepieces, and desired auxiliary lens attachments. The diagonally cut rack-and-pinion focusing adjustment has adjustable tension. The working distance ranges up to 8 in. (American Optical Co., Dept. S53)

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POSITIONS WANTED

B.A. (major: chmistry; minors: mathematics and physics); **M.S.** (major: oceanography; minor: geology); interested industrial and fundamental research in organic and electrochemistry; 10 years' industrial research, 4 years consulting, chemist to several companies in industry. S11-10 Medical Bureau (Burneice Larson, Director), 900 North Michigan, Chicago. X

Mathematician, M.A. Later training; 13 years' laboratory experience; physics, engineering problems, analysis, machine computation, statistics, reports; preference, research for civilian industry. Box 254, SCIENCE. X

Research Scientist; M.D.; private practice, medical administration outside United States; 2 years' postgraduate medical and research training, United States; 5 years' medical research, well-known United States university; seeks high-level appointment, research laboratory. Woodward Medical Personnel Bureau, 185 North Wabash, Chicago. X

POSITIONS OPEN

(a) Assistant Director, organization specializing in research involving medical statistics and auditing; experience in clinical medicine required; physician, preferably internist, required. **(b) Scientists with Research Administration Backgrounds;** experienced research involving therapy, etiology, and pathogenesis of cancer. **(c) Medical Director,** newly created department, major pharmaceutical company; pediatrician, anesthesiologist, or surgeon experienced fluid therapy might be interested; Midwest. **(d) Chemist or Biochemist;** medical school research department; present projects involve research on steroids, hormones; if Ph.D., $8000; West. **(e) Biochemist;** Ph.D. or M.D.; experienced enzyme chemistry; qualified direct department, 600-bed teaching hospital; East. S11-10, Medical Bureau (Burneice Larson, Director), 900 North Michigan, Chicago. X

Biochemist–Laboratory Technologist. Excellent opportunity with permanent future for dynamic and experienced individual in growing organization in Los Angeles. Box 255, SCIENCE. 11/23, 30

Biochemist, Ph.D. preferred. Trained primarily in protein chemistry. Knowledge of enzyme chemistry, chromatographic methods, electrophoresis, and some organic chemistry preferred. Salary $7000 per year. Write to Box 250, SCIENCE. 11/9, 16, 23, 30

Enzymologist. Opportunity to organize own group in expanding research department. Prefer Ph.D. in biochemistry or bacteriology with extensive knowledge of industrial enzyme field. Liberal profit sharing retirement and insurance benefits; Midwest. Box 251, SCIENCE. 11/9, 16

Geology Teacher for expanding program; Ph.D. or M.S. State training, experience and availability. Retired teachers invited to inquire. Southeast Missouri State College, Cape Girardeau, Missouri. 11/16, 23, 30

Histological Technician, experienced. Immediate opening with neurology research group, Boston, Massachusetts. Salary to $3800. Box 253, SCIENCE. X

OPPORTUNITY AVAILABLE FOR YOUNG PHYSICIAN—

in Professional Service Department of Medical Division. Should have ability and interest in medical writing. Clinical or laboratory research experience desirable. Large midwestern ethical pharmaceutical company. For further details please write and send résumé to Box 252, SCIENCE.

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Publication of research results in the appropriate classified or open literature is encouraged.

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Company has modern research facilities, complete employee benefit program, and is located in rural area of central New York State. Forward résumés to Personnel Director, The Norwich Pharmacal Company, Norwich, New York.

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POSITIONS REQUIRING DEGREES IN MEDICINE OR SCIENCE: (a) Bacteriologist; clinical appointment, laboratory of 150-bed general hospital; work under highly qualified, noted pathologist; to $6000; southeastern resort area. **(b) Biochemist** (M.S. or Ph.D.) and **Bacteriologist** (B.S. or M.S.); to head respective sections, newly reorganized, exceptionally well-equipped laboratory under supervision of qualified pathologist; superior facilities and working conditions; biochemist should be trained or interested in radioisotopes; bacteriologist will also supervise parasitology; serology; 300-bed facility; to $7500 and about $5400, respectively; Midwest. **(c) Senior Research Associate;** Ph.D. physiologist also trained in biochemistry; to head division of physiology and pharmacology, important eastern concern; prefer trained reproduction physiology, experienced animal physiology laboratory; to $7500. **(d) Immunochemist;** Ph.D. also trained in biochemistry, central allergy research laboratory, federally operated; prepare extracts for testing, treatment of allergies; $7500; East. Woodward Medical Personnel Bureau, 185 North Wabash, Chicago. X

Radiochemist, Ph.D., with biological interests for responsible position in radioisotope research at large cancer research center. Experience in instrumentation and biochemical applications necessary. Box 249, SCIENCE. 11/9, 16

Science Writer for new 516-bed research hospital and basic science research institute. Basic policy clinical and basic science research into the problem of cancer and allied diseases. Salary open. Qualifications: bachelor's degree and 2 years of writing experience. Box 221, SCIENCE. ew 11/23

Teaching Position in Mathematics. Open February or September 1957. Rank and salary dependent on experience and qualifications. Write College of Arts and Sciences, Duquesne University, Pittsburgh 19, Pennsylvania. 11/9

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Program content

1. The two-session general symposium, "Moving Frontiers of Science," arranged by the Committee on AAAS Meetings.
2. The six sessions of the Conference on Scientific and Technical Editorial Problems.
3. Details of the anniversary celebrations of the AAAS-Gordon Research Conferences, Botanical Society of America, Freud *et al.*
4. Programs of the 18 AAAS sections (symposia and contributed papers).
5. Programs of the more than 80 participating societies.
6. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Manpower, National Geographic Society, Phi Beta Kappa, RESA, Sigma Xi.
7. Details of the Hotel Statler—center of the Meeting—and other hotels and session sites.
8. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
9. Exhibitors in the 1956 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1956.
2. Complete roll of AAAS presidents and their fields.
3. The more than 265 affiliated organizations.
4. Historical sketch and organization of the Association; the 1955 revised Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS through 1962.
11. New and current activities of the AAAS.

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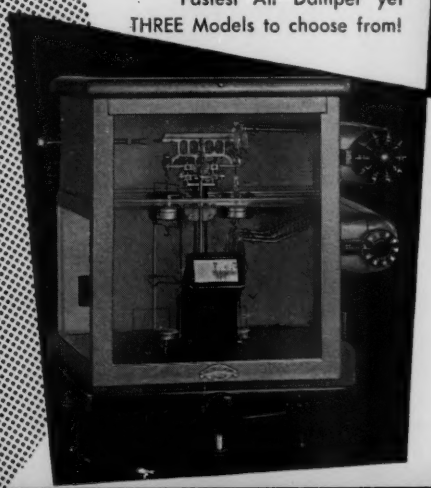

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